APPENDICES

APPENDIX 1 LEGEND

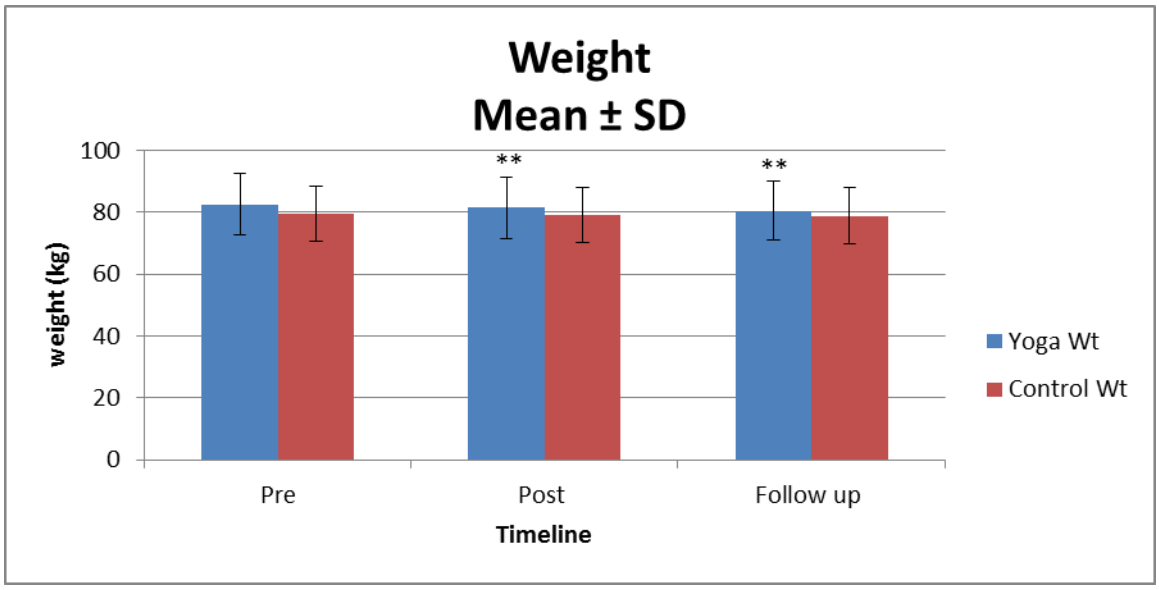
Sl. No.	Parameter/details	Description	Unit/Remarks
1	Ht	Height	cm
2	Wt	Weight	Kg
3	Macl	Mid arm circumference Left	cm
4	Macr	Mid arm circumference Right	cm
5	Wc	Waist circumference	cm
6	Hip	Hip circumference	cm
7	Rafr	Right arm front	mm
8	Rab	Right arm back	mm
9	Stof	Stomach front	mm
10	Shob	Shoulder back	mm
11	Bmi	Body mass index	kg/m^2
12	Whr	Waist hip ratio	ratio
13	Absi	A body shape index	ratio
14	Skft	Skin fold thickness	mm
15	Pfc	Percentage body fat from skin fold	percentage
16	Ghqs	General health questionnaire scoring (0011)	score
17	Ghml	General health questionnaire (0012) modified likert scoring	score
18	Pss	Perceived stress scale	score

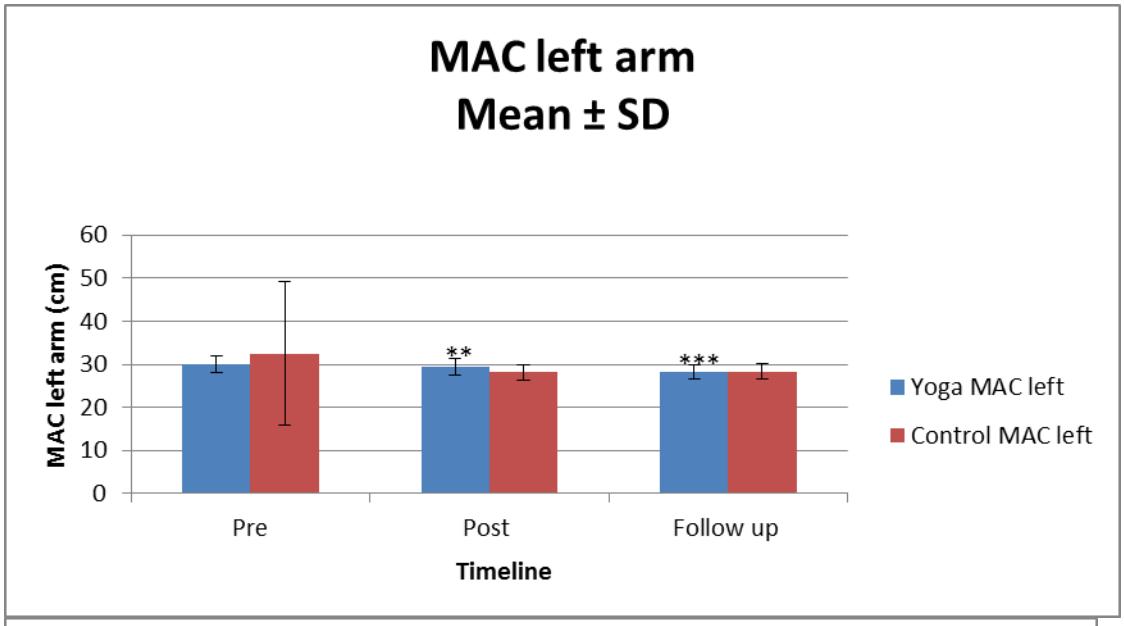
19	Phq	Patient health questionnaire	score
20	Maas	Mindful attention awareness scale mean value	score
21	Ipqr	IPAQ Regular total score	score
22	aaqw	Acceptance and action questionnaire for weight related difficulties	score
23	Brqf	Behavioral regulation in exercise questionnaire-2 final score	score
24	psqi	Pittsburgh sleep quality index	score
25	Bmr	Basal metabolic rate (BMR)	kcal.
26	Bm	Bone mineral content	kg
27	Obd	Obesity degree (current weight divided by ideal weight multiplied by 100)	ratio
28	Smm	Skeltal muscle mass	kg
29	Fm	Body fat mass	kg
30	Pfin	Percentage body fat from InBody R20	percentage
31	Aobd	Abdominal obesity degree (waist hip ratio from InBody R20)	ratio
32	Ralm	Right arm lean mass	kg
33	Lalm	Left arm lean mass	kg
34	Tlm	Trunk lean mass	kg
35	Rllm	Right leg lean mass	kg
36	Lllm	Left leg lean mass	Kg

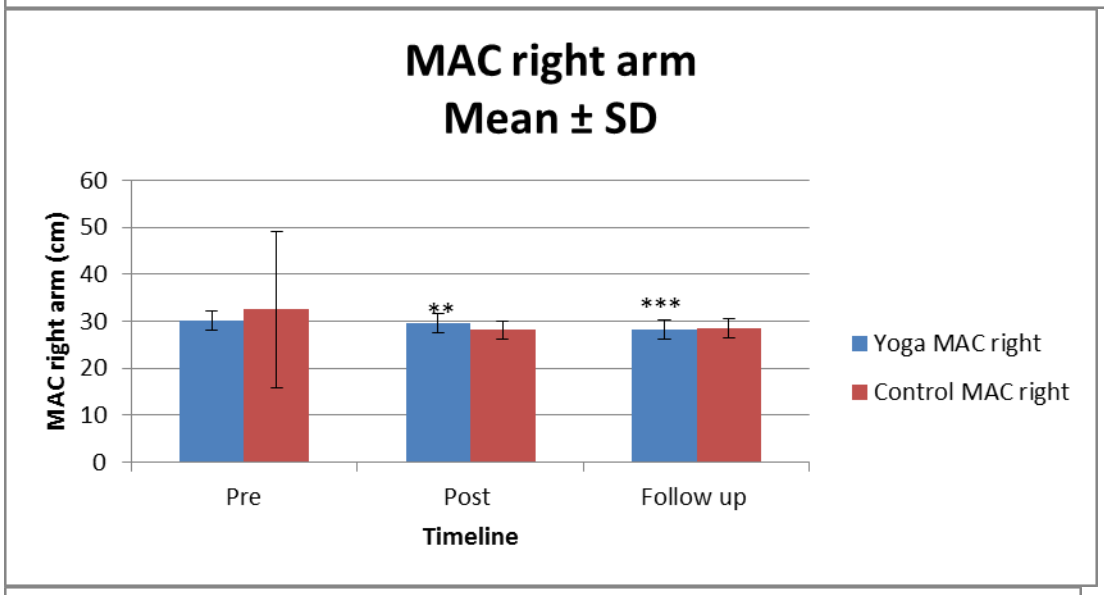
37	Wmra	Water mass of right arm	kg
38	Wmla	Water mass of left arm	kg
39	Wmt	Water mass of trunk	kg
40	Wmrl	Water mass of right leg	kg
41	Wmll	Water mass of left leg	kg
42	Pfra	Percentage body fat of right arm	percentage
43	Pfla	Percent body fat of left arm	percentage
44	Pft	Percent body fat for trunk	percentage
45	Pfrl	Percent body fat of right leg	percentage
46	Pfll	Percent body fat of left leg	percentage
47	Pm	Protein mass	kg
48	Mm	Mineral mass	kg
49	Tbwm	Total body water mass	kg
50	Sklm	Skeletal lean mass	kg
51	ffm	Fat free mass	kg

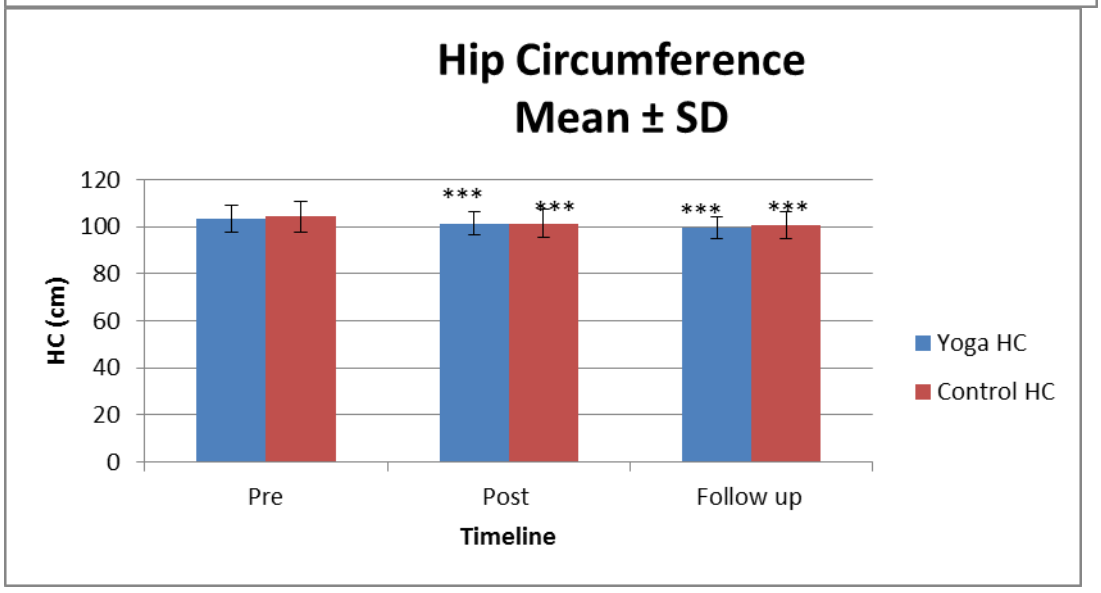
APPENDIX 2 OUTCOME CHART

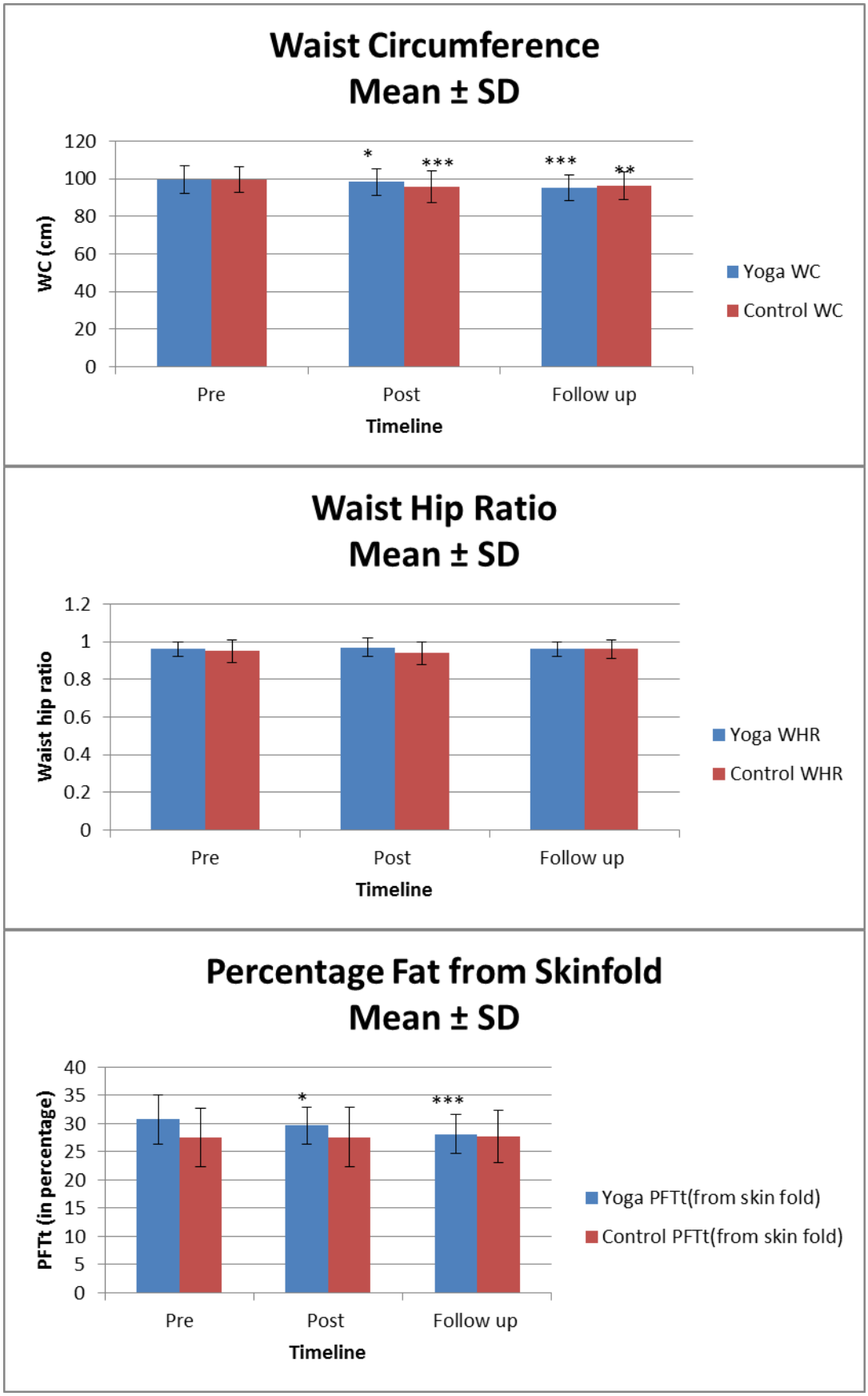
ANTHROPOMETRIC PARAMETERS:

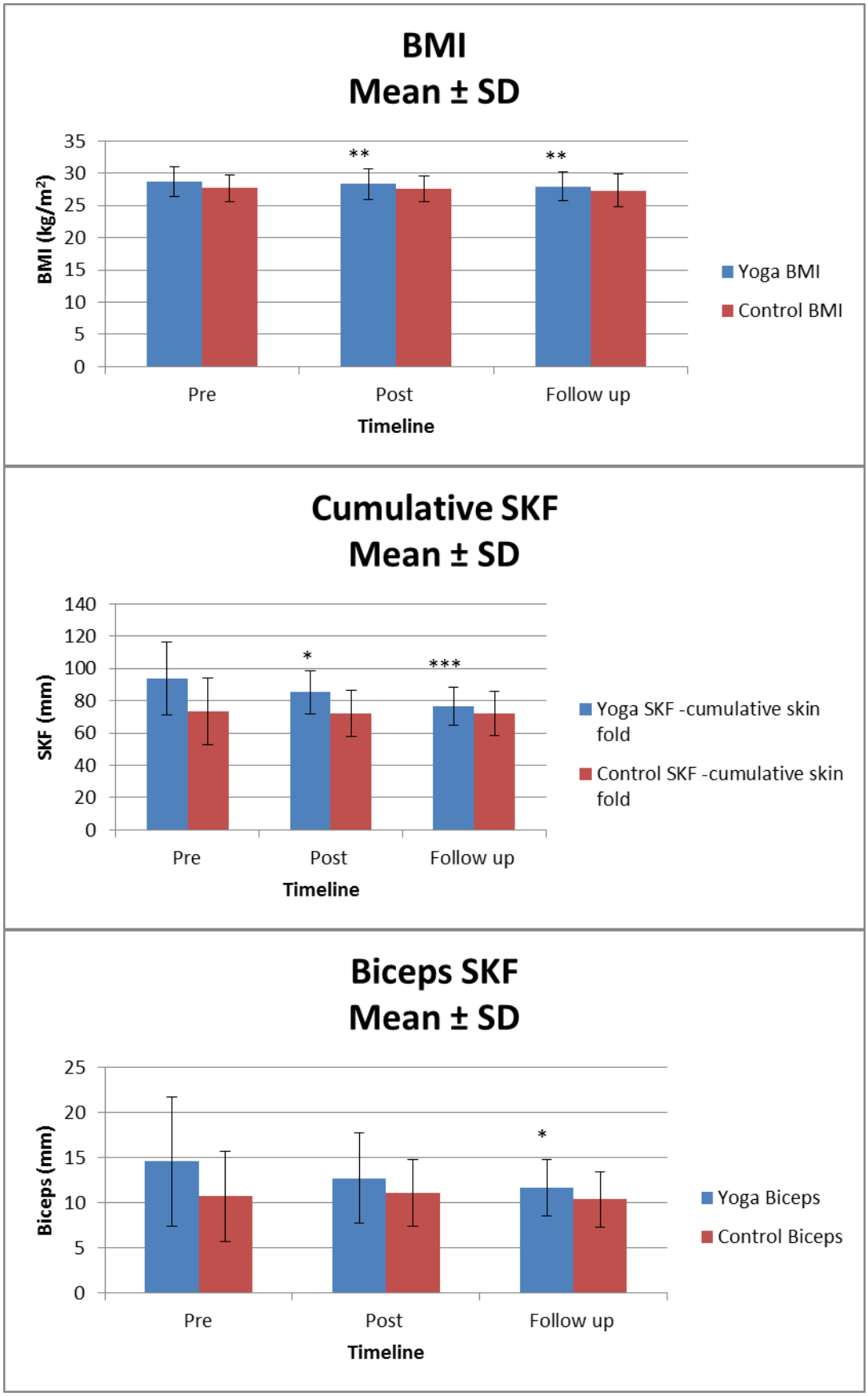


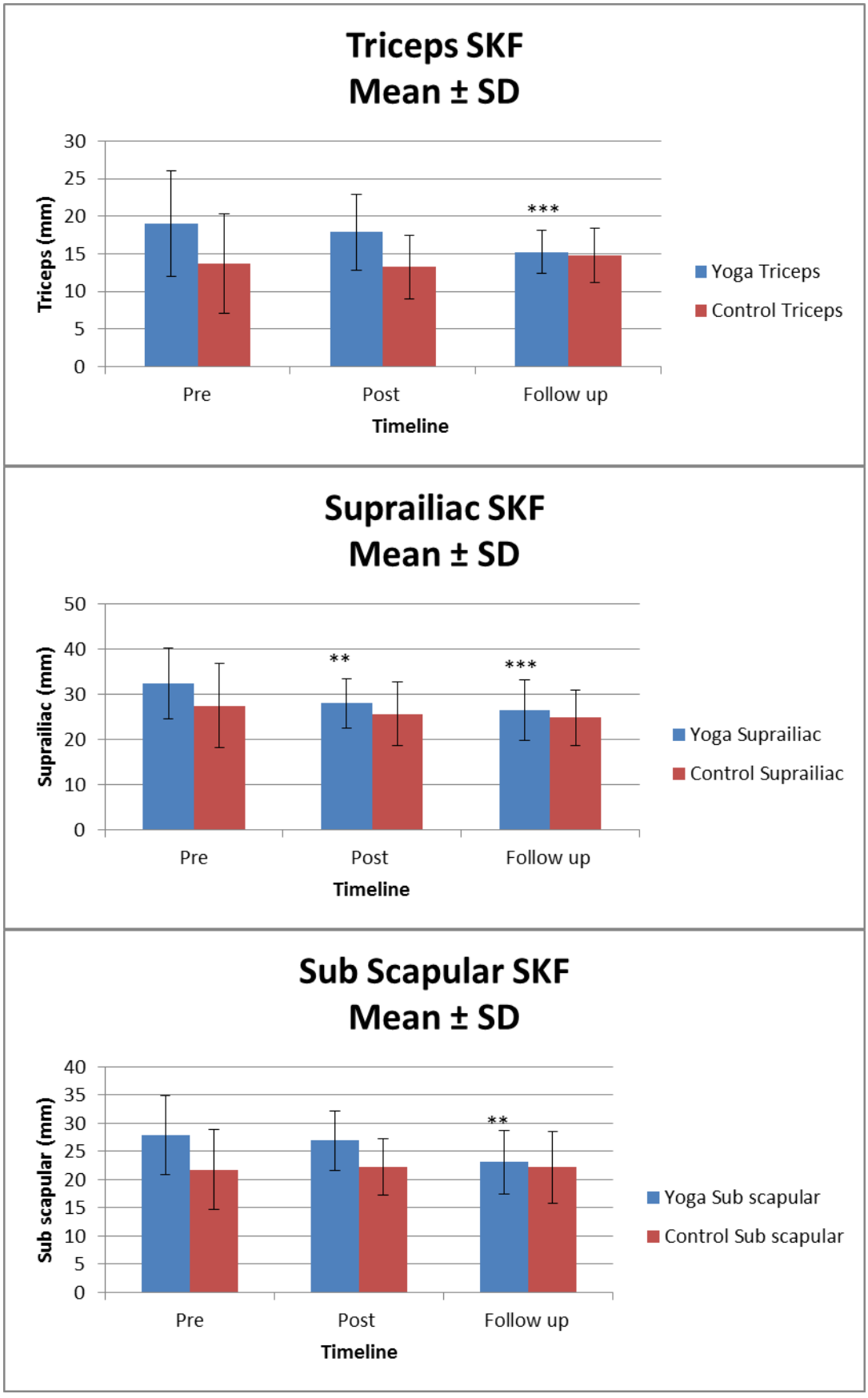

MAC left arm
Mean ± SD
MAC left arm (cm)
60
50
40
30
20
10
0
**
***
Pre
Post
Follow up
Timeline
Yoga MAC left
Control MAC left


MAC right arm
Mean ± SD
MAC right arm (cm)
60
50
40
30
20
10
0
**
***
Pre
Post
Follow up
Timeline
Yoga MAC right
Control MAC right

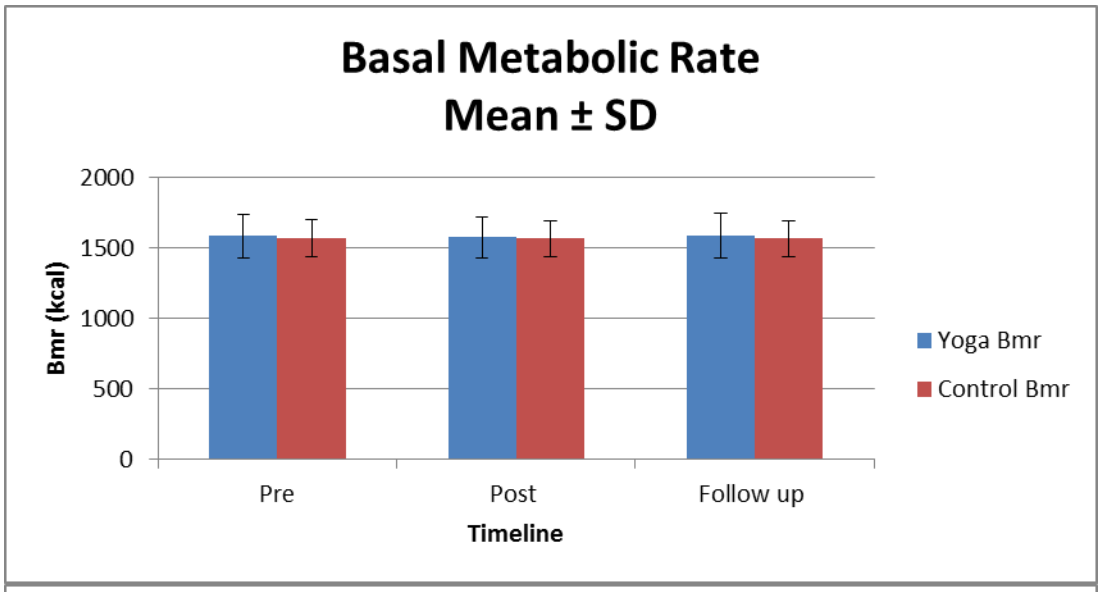

Hip Circumference
Mean ± SD
HC (cm)
120
100
80
60
40
20
0
***
***
***
***
Pre
Post
Follow up
Timeline
Yoga HC
Control HC

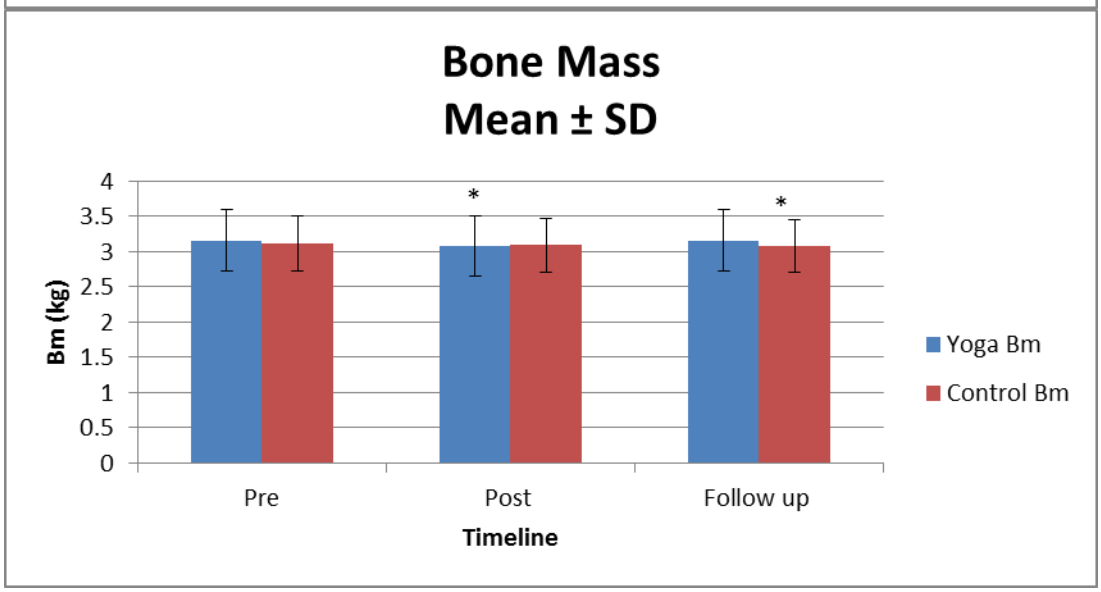

Waist Circumference
Mean ± SD
WC (cm)
120
100
80
60
40
20
0
*
***
***
**
Pre
Post
Follow up
Timeline
Yoga WC
Control WC
Waist Hip Ratio
Mean ± SD
Waist hip ratio
1.2
1
0.8
0.6
0.4
0.2
0
Pre
Post
Follow up
Timeline
Yoga WHR
Control WHR
Percentage Fat from Skinfold
Mean ± SD
PFTt (in percentage)
40
35
30
25
20
15
10
5
0
*
***
Pre
Post
Follow up
Timeline
Yoga PFTt(from skin fold)
Control PFTt(from skin fold)

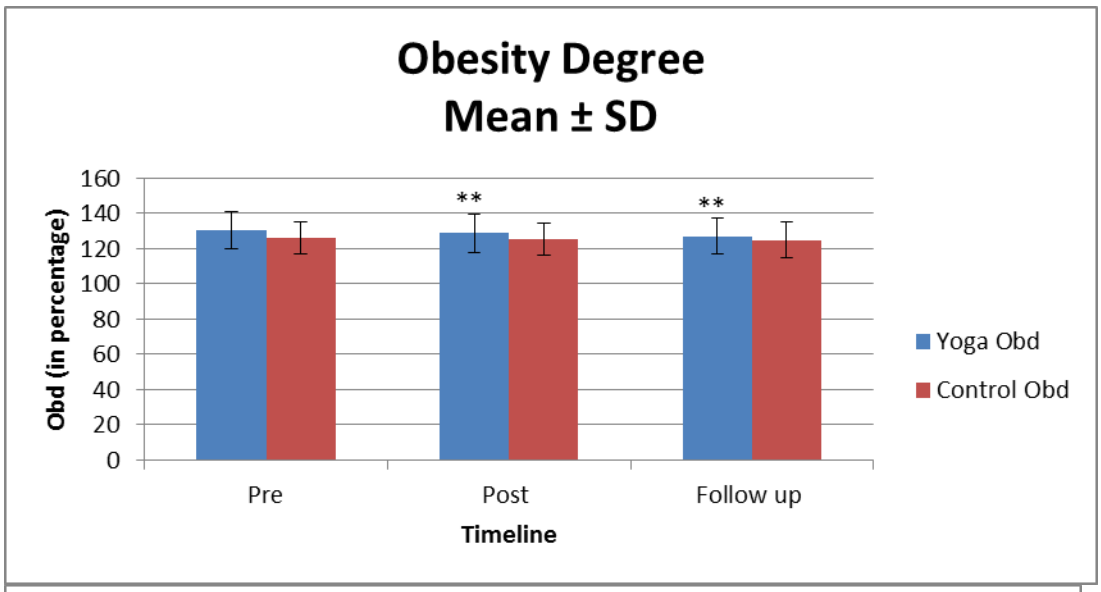

BMI
Mean ± SD
BMI (kg/m²)
35
30
25
20
15
10
5
0
**
**
Pre
Post
Follow up
Timeline
Yoga BMI
Control BMI
Cumulative SKF
Mean ± SD
SKF (mm)
140
120
100
80
60
40
20
0
*
***
Pre
Post
Follow up
Timeline
Yoga SKF -cumulative skin fold
Control SKF -cumulative skin fold
Biceps SKF
Mean ± SD
Biceps (mm)
25
20
15
10
5
0
*
Pre
Post
Follow up
Timeline
Yoga Biceps
Control Biceps

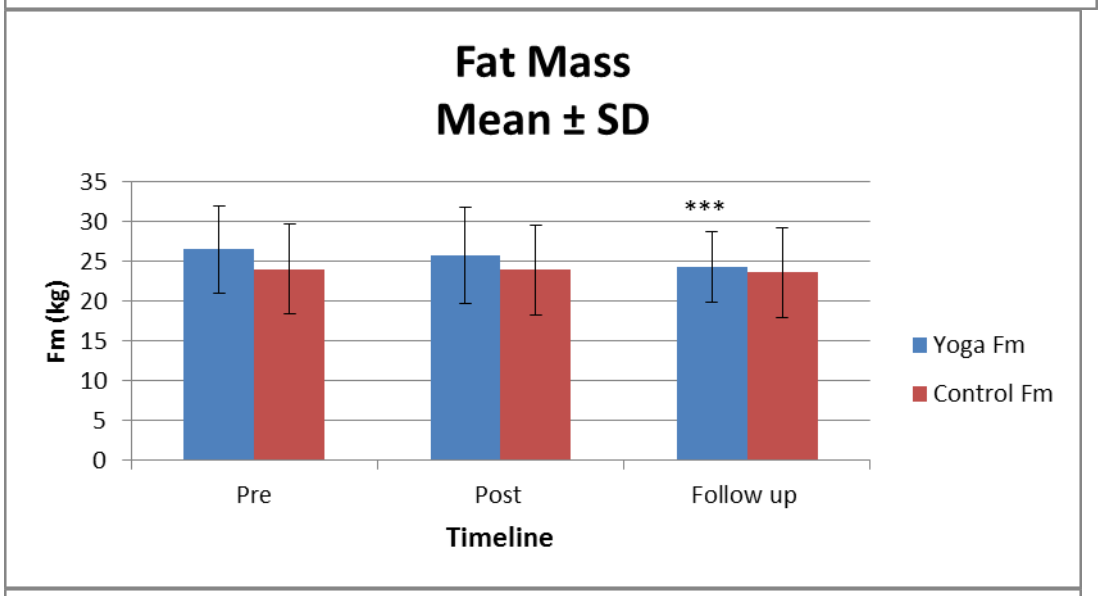

Triceps SKF
Mean ± SD
Triceps (mm)
30
25
20
15
10
5
0
***
Pre
Post
Follow up
Timeline
Yoga Triceps
Control Triceps
Suprailiac SKF
Mean ± SD
Suprailiac (mm)
50
40
30
20
10
0
**
***
Pre
Post
Follow up
Timeline
Yoga Suprailiac
Control Suprailiac
Sub Scapular SKF
Mean ± SD
Sub scapular (mm)
40
35
30
25
20
15
10
5
0
**
Pre
Post
Follow up
Timeline
Yoga Sub scapular
Control Sub scapular

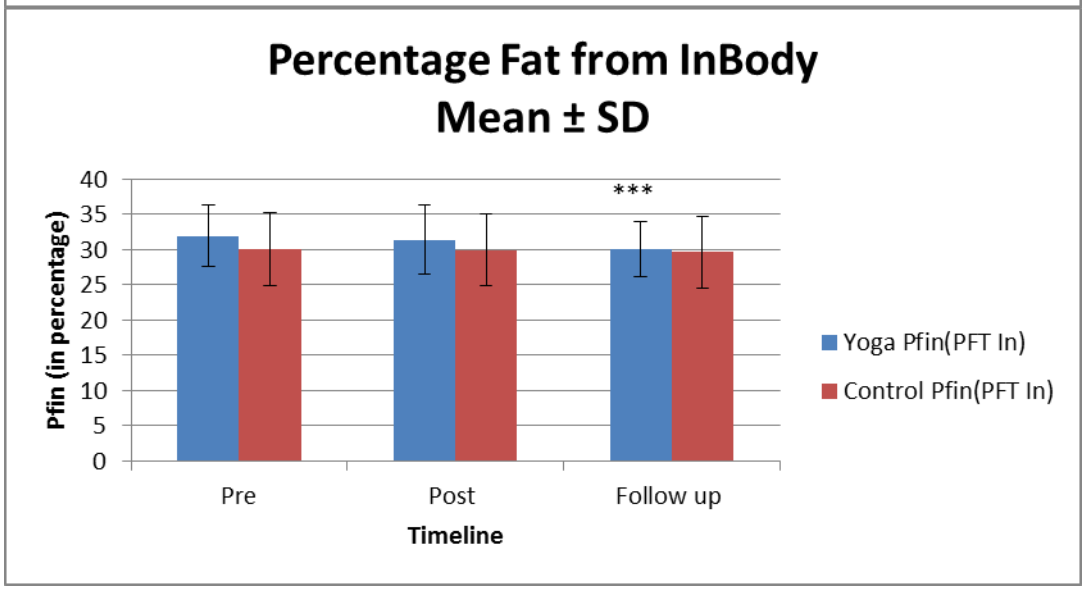
BODY COMPOSITION PARAMETERS:

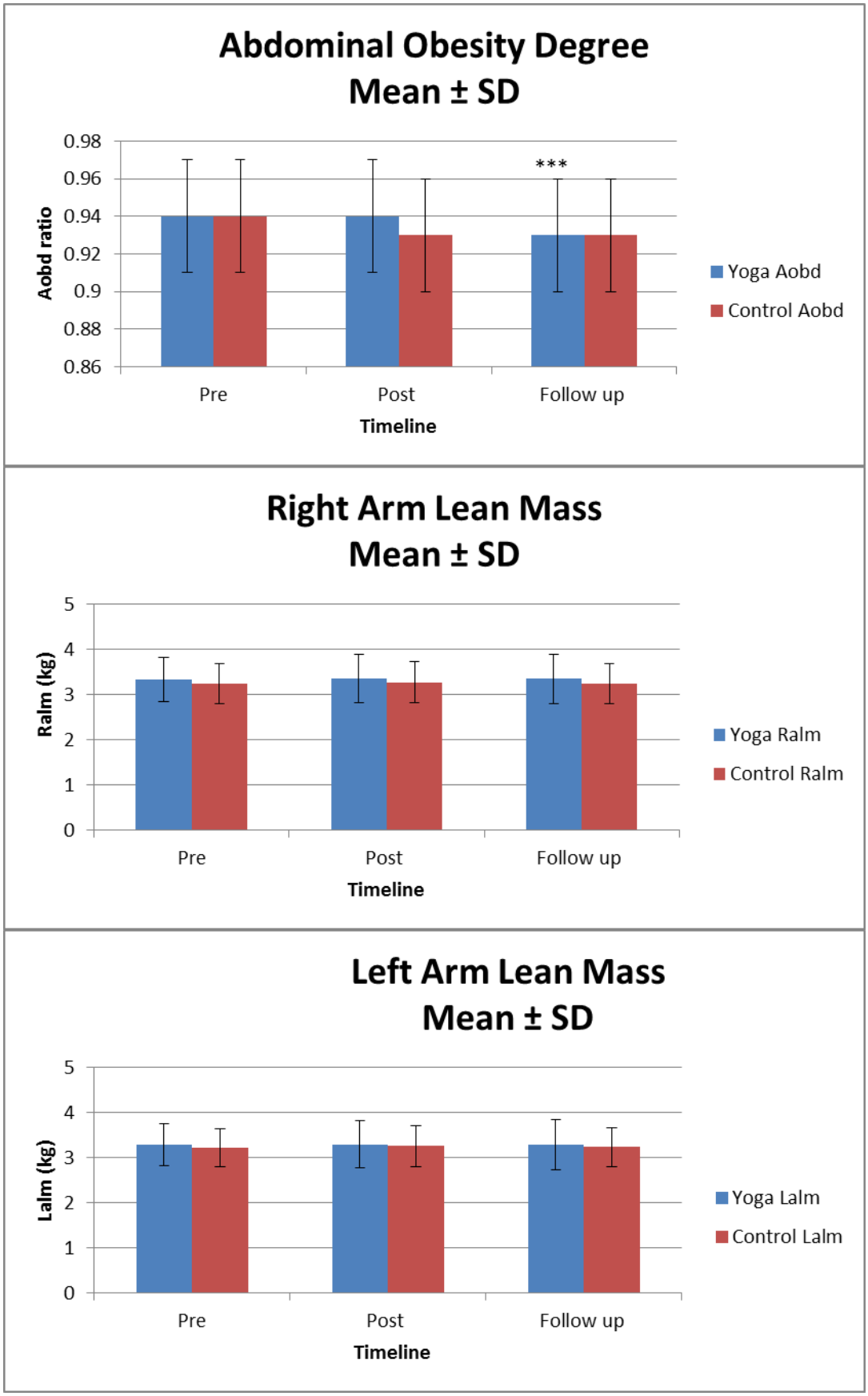


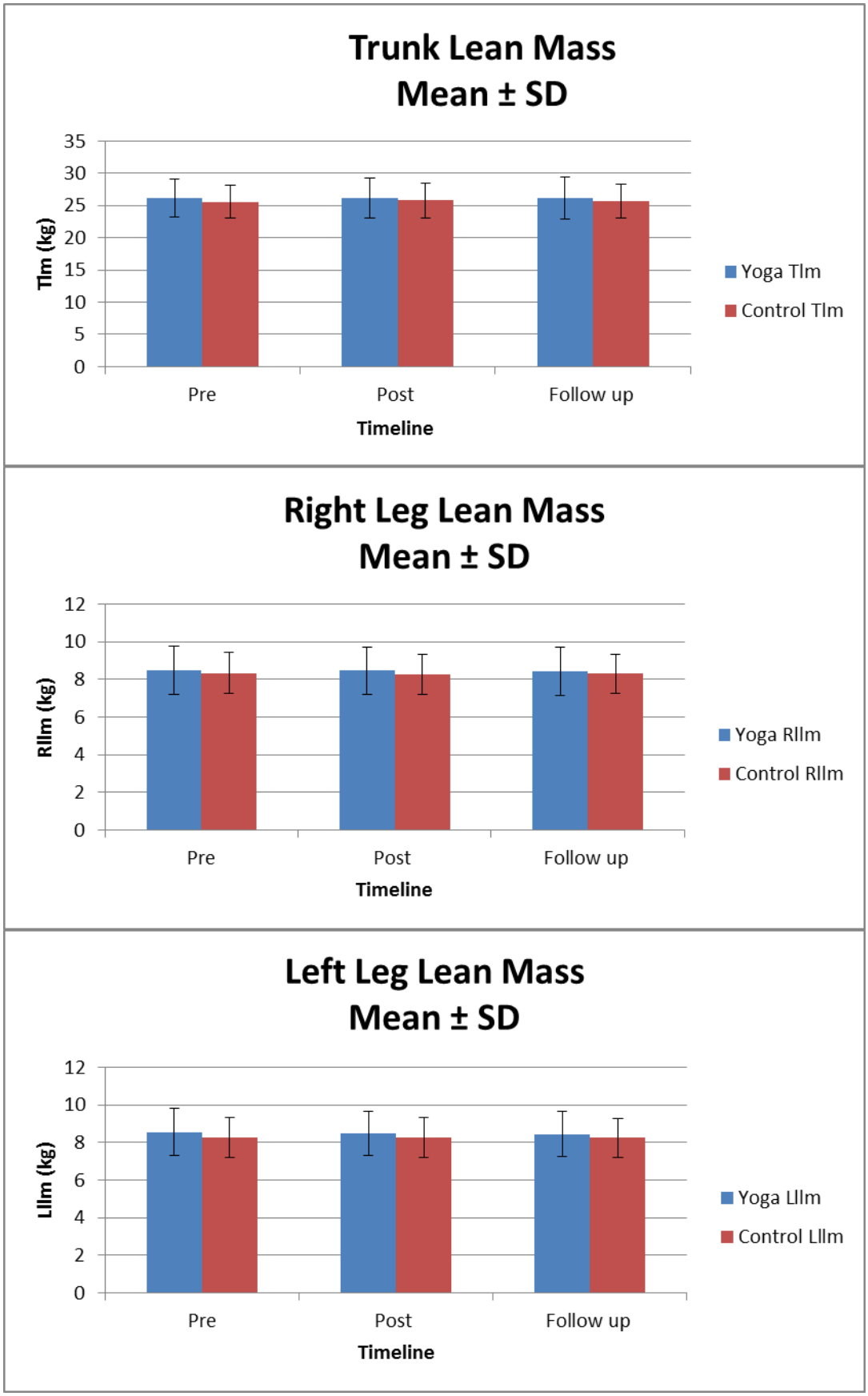


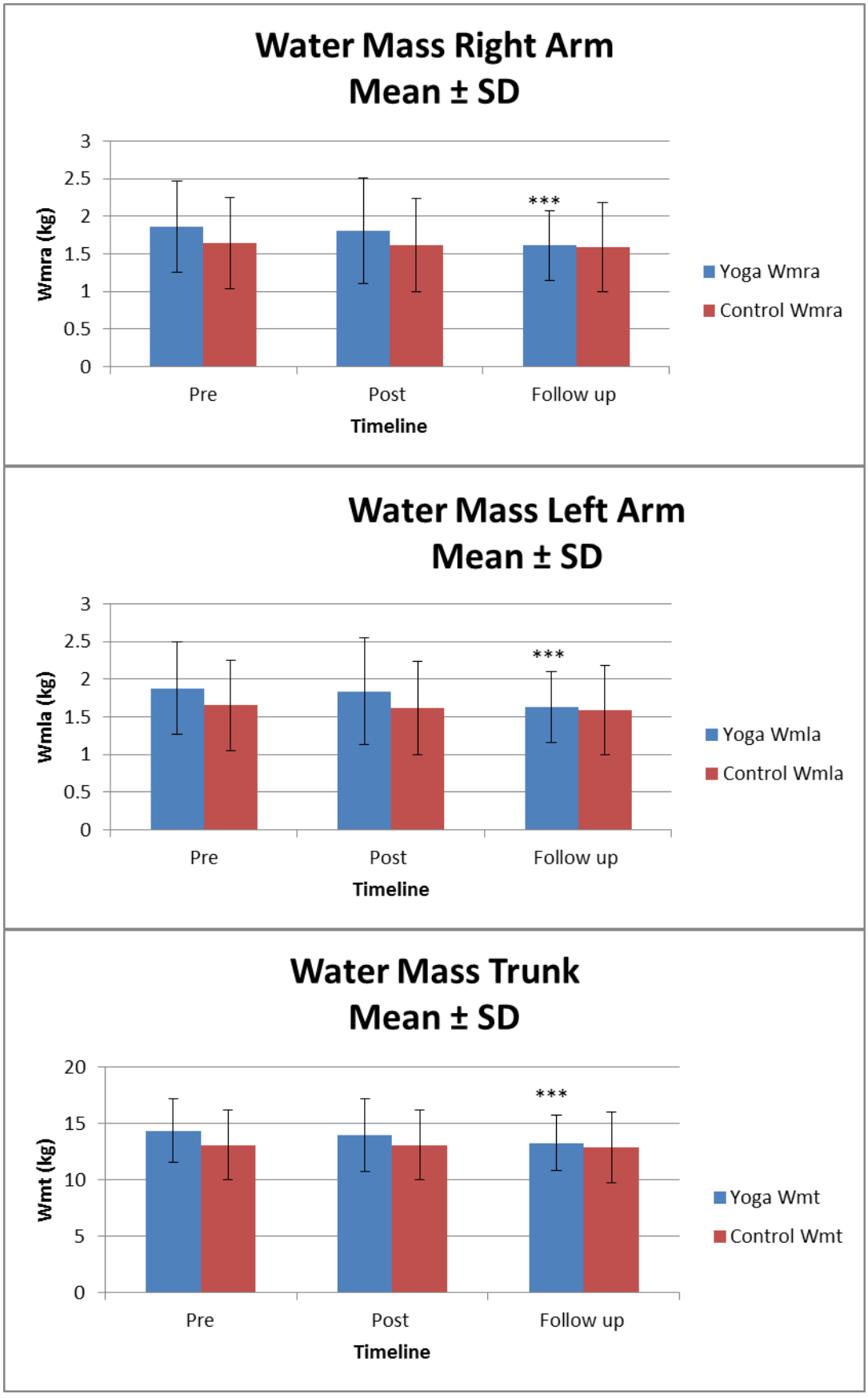

Obesity Degree
Mean ± SD
160
140
120
100
80
60
40
20
0
Obd (in percentage)
**
**
Pre
Post
Follow up
Timeline
Yoga Obd
Control Obd

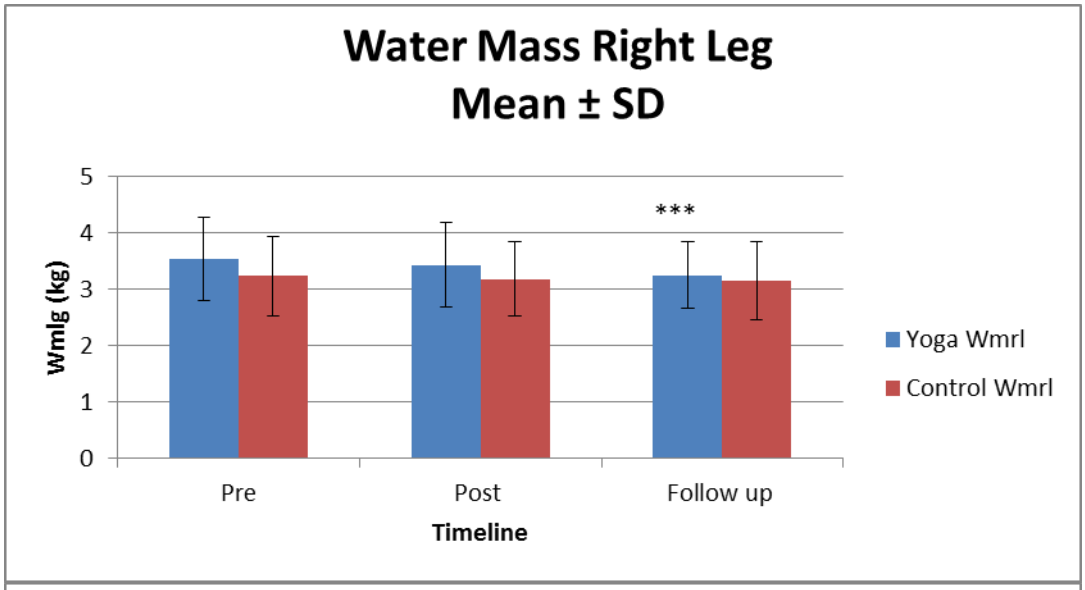

Fat Mass
Mean ± SD
35
30
25
20
15
10
5
0
Fm (kg)
***
Pre
Post
Follow up
Timeline
Yoga Fm
Control Fm

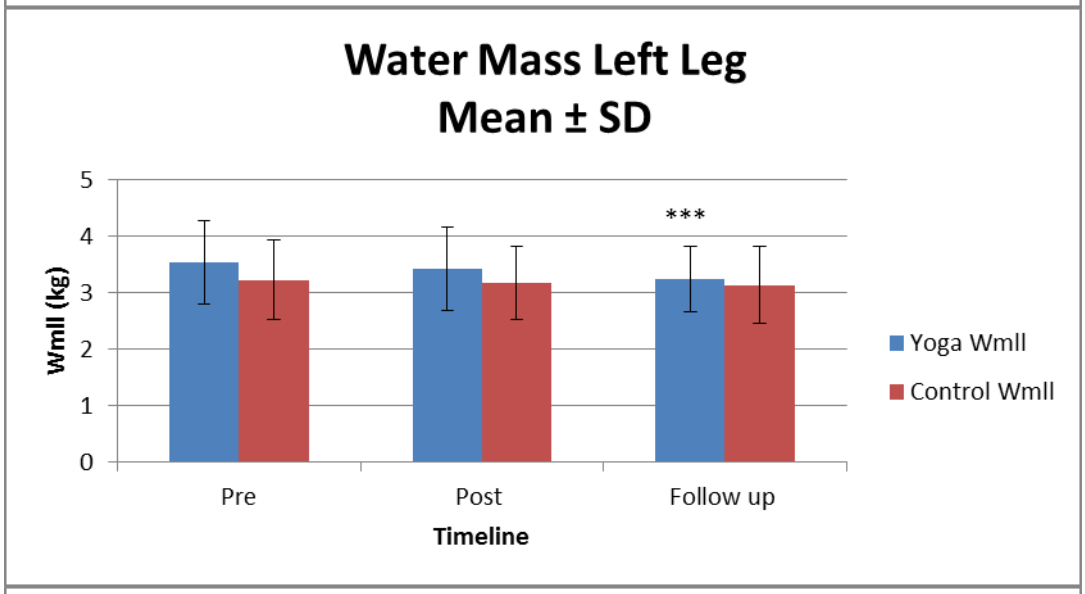

Percentage Fat from InBody
Mean ± SD
40
35
30
25
20
15
10
5
0
Pfin (in percentage)
***
Pre
Post
Follow up
Timeline
Yoga Pfin(PFT In)
Control Pfin(PFT In)

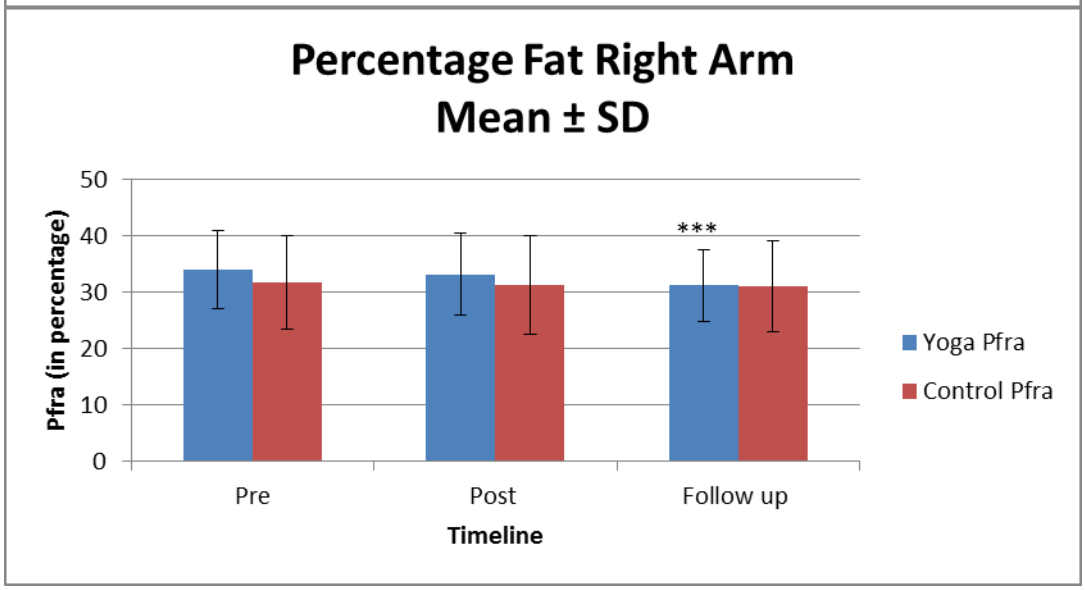

Abdominal Obesity Degree
Mean ± SD
0.98
0.96
0.94
0.92
0.9
0.88
0.86
Aobd ratio
***
Pre
Post
Follow up
Timeline
Yoga Aobd
Control Aobd
Right Arm Lean Mass
Mean ± SD
5
4
3
2
1
0
Ralm (kg)
Pre
Post
Follow up
Timeline
Yoga Ralm
Control Ralm
Left Arm Lean Mass
Mean ± SD
5
4
3
2
1
0
Lalm (kg)
Pre
Post
Follow up
Timeline
Yoga Lalm
Control Lalm

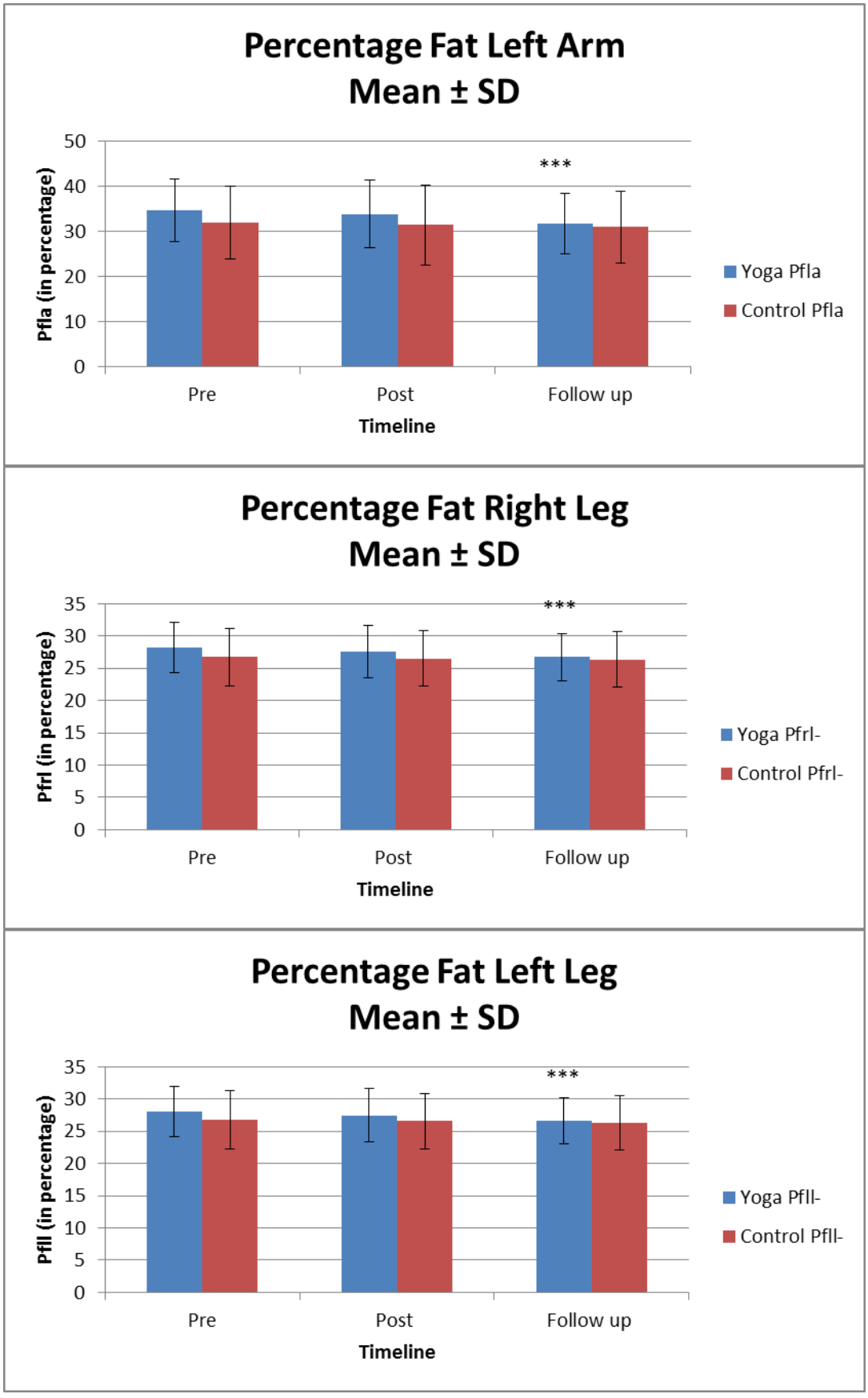

Trunk Lean Mass
Mean ± SD
Tlm (kg)
35
30
25
20
15
10
5
0
Pre
Post
Follow up
Timeline
Yoga Tlm
Control Tlm
Right Leg Lean Mass
Mean ± SD
Rllm (kg)
12
10
8
6
4
2
0
Pre
Post
Follow up
Timeline
Yoga Rllm
Control Rllm
Left Leg Lean Mass
Mean ± SD
Lllm (kg)
12
10
8
6
4
2
0
Pre
Post
Follow up
Timeline
Yoga Lllm
Control Lllm

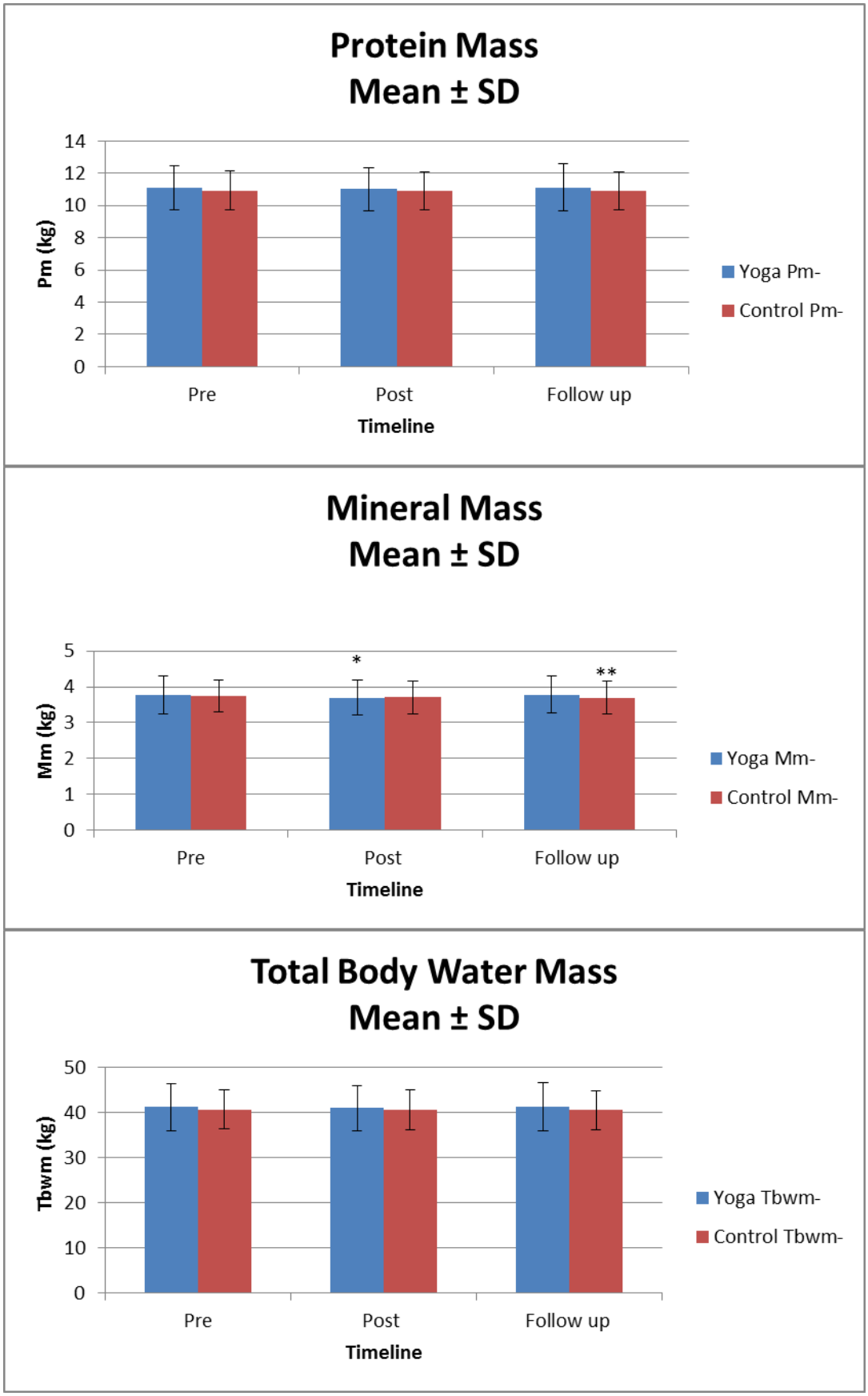

Water Mass Right Arm
Mean ± SD
Wmra (kg)
3
2.5
2
1.5
1
0.5
0
***
Pre
Post
Follow up
Timeline
Yoga Wmra
Control Wmra
Water Mass Left Arm
Mean ± SD
Wmla (kg)
3
2.5
2
1.5
1
0.5
0
***
Pre
Post
Follow up
Timeline
Yoga Wmla
Control Wmla
Water Mass Trunk
Mean ± SD
Wmt (kg)
20
15
10
5
0
***
Pre
Post
Follow up
Timeline
Yoga Wmt
Control Wmt

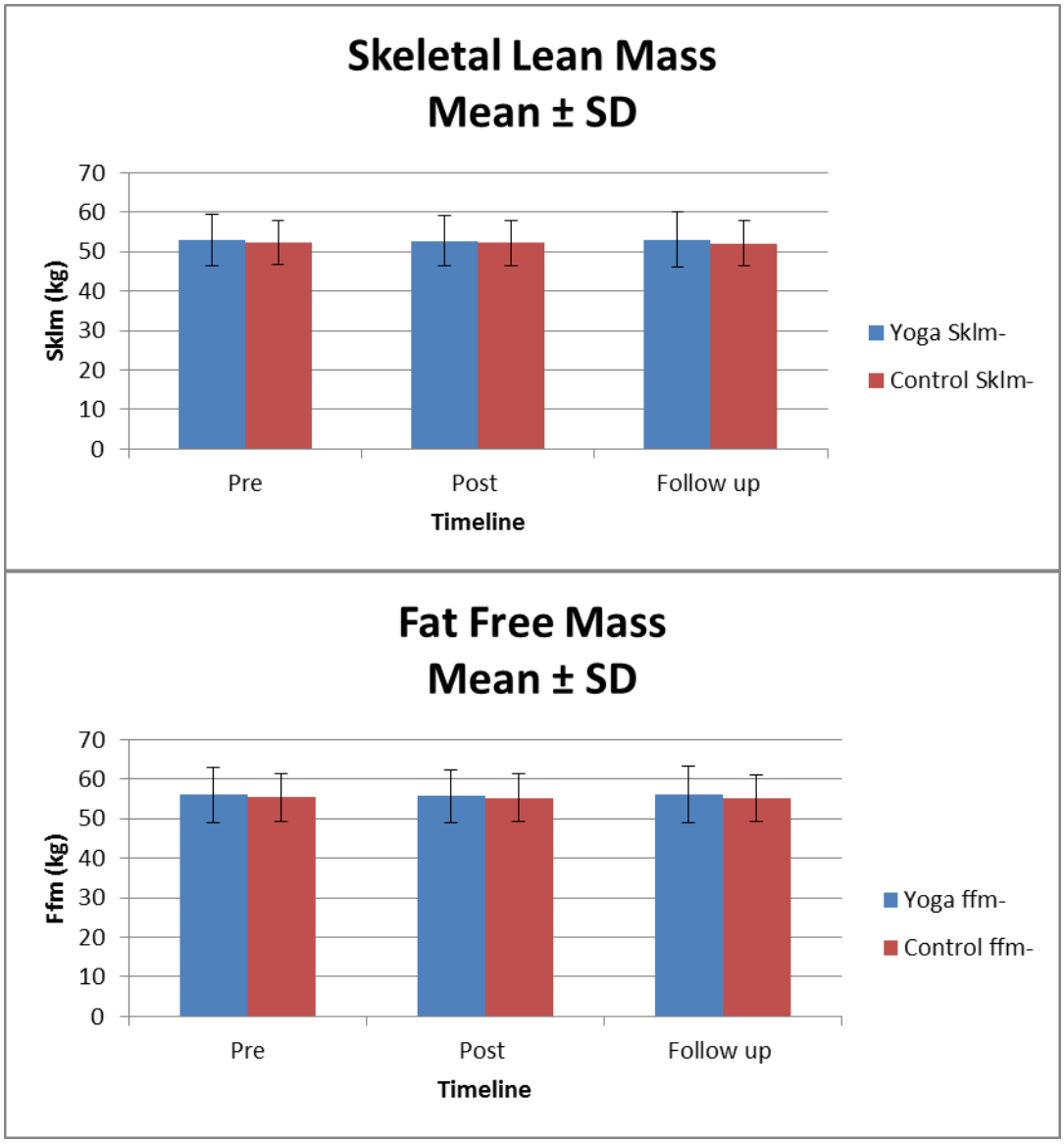

Water Mass Right Leg
Mean ± SD
Wmlg (kg)
5
4
3
2
1
0
***
Pre
Post
Follow up
Timeline
Yoga Wmrl
Control Wmrl


Water Mass Left Leg
Mean ± SD
Wmll (kg)
5
4
3
2
1
0
***
Pre
Post
Follow up
Timeline
Yoga Wmll
Control Wmll

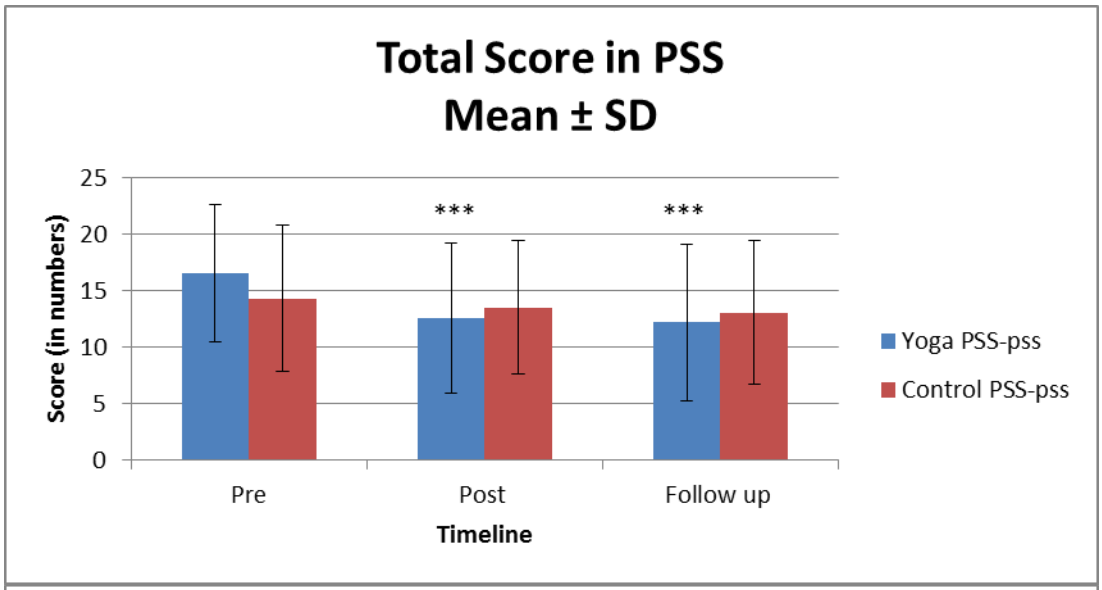

Percentage Fat Right Arm
Mean ± SD
Pfra (in percentage)
50
40
30
20
10
0
***
Pre
Post
Follow up
Timeline
Yoga Pfra
Control Pfra

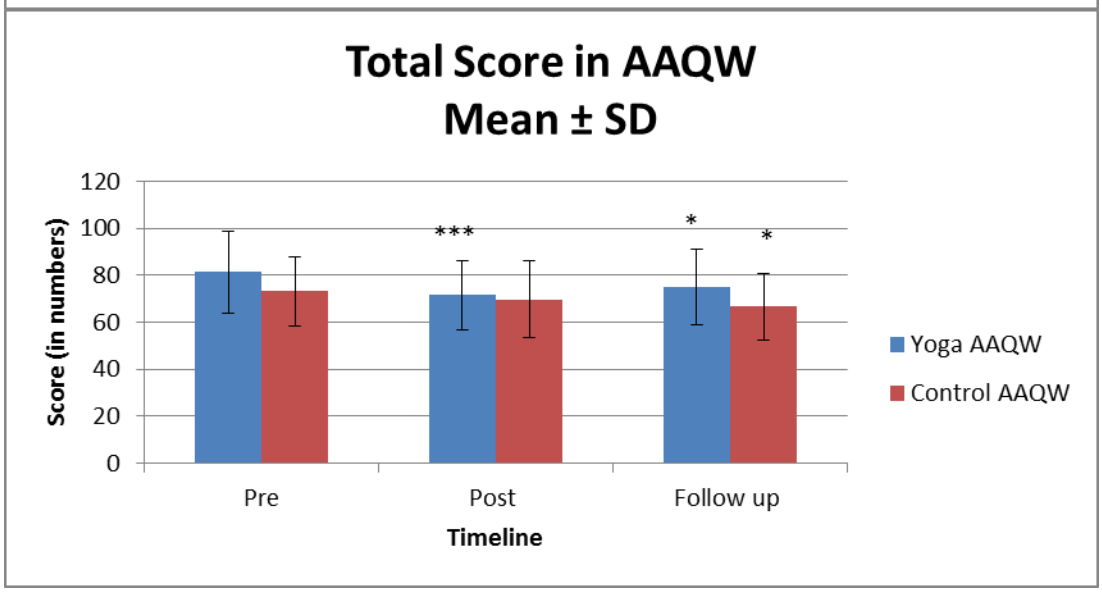

Percentage Fat Left Arm
Mean ± SD
Pfla (in percentage)
50
40
30
20
10
0
***
Pre
Post
Follow up
Timeline
Yoga Pfla
Control Pfla
Percentage Fat Right Leg
Mean ± SD
Pfrl (in percentage)
35
30
25
20
15
10
5
0
***
Pre
Post
Follow up
Timeline
Yoga Pfrl-
Control Pfrl-
Percentage Fat Left Leg
Mean ± SD
Pfll (in percentage)
35
30
25
20
15
10
5
0
***
Pre
Post
Follow up
Timeline
Yoga Pfll-
Control Pfll-

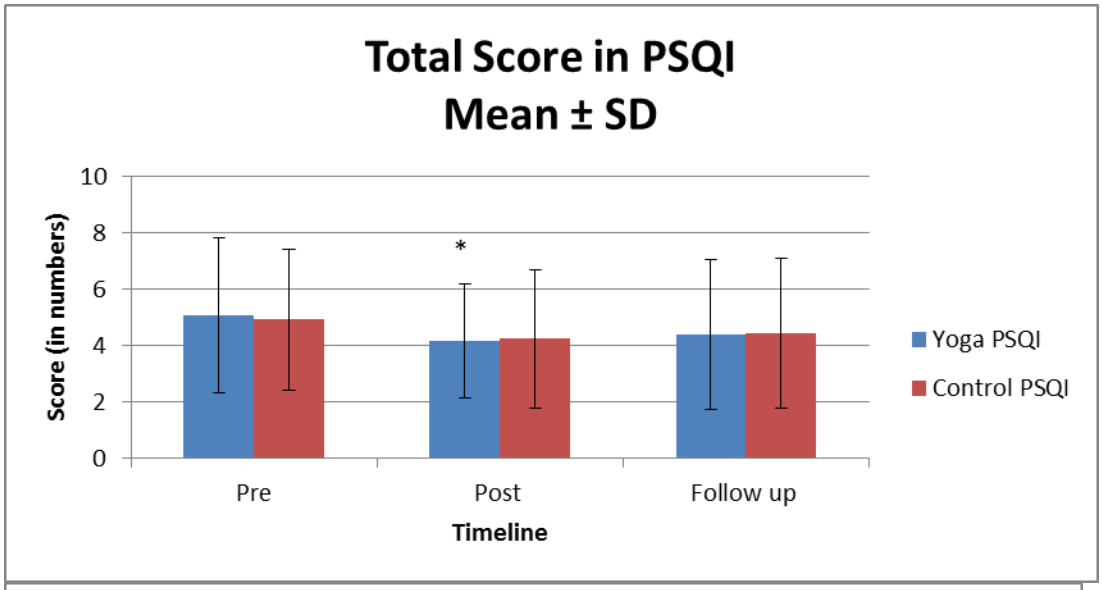

Protein Mass
Mean ± SD
Pm (kg)
14
12
10
8
6
4
2
0
Pre
Post
Follow up
Timeline
Yoga Pm-
Control Pm-
Mineral Mass
Mean ± SD
Mm (kg)
5
4
3
2
1
0
*
**
Pre
Post
Follow up
Timeline
Yoga Mm-
Control Mm-
Total Body Water Mass
Mean ± SD
Tbwm (kg)
50
40
30
20
10
0
Pre
Post
Follow up
Timeline
Yoga Tbwm-
Control Tbwm-

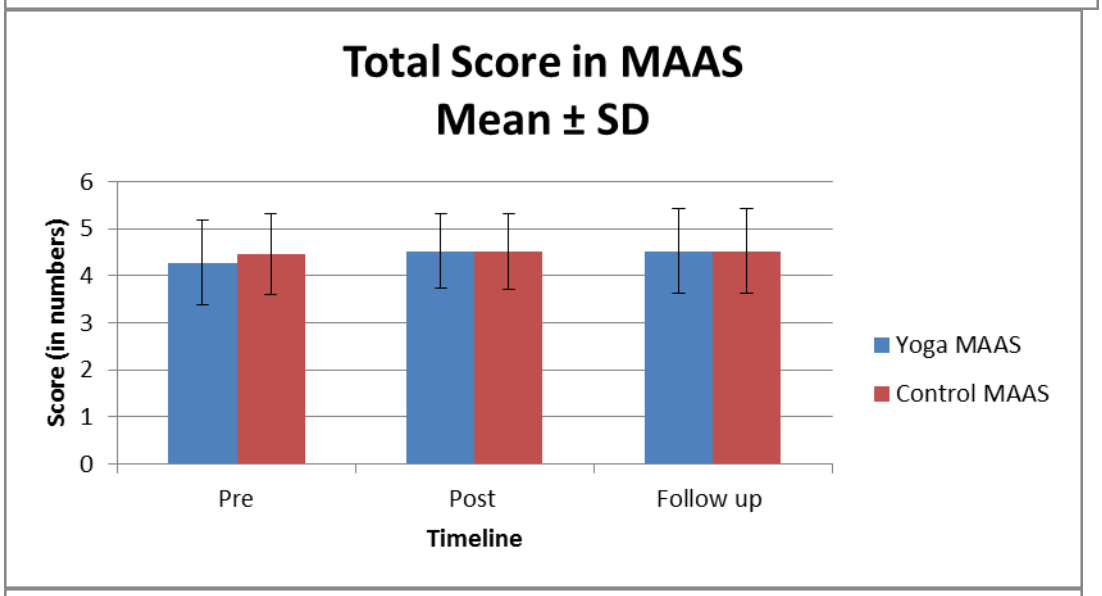

Skeletal Lean Mass
Mean ± SD
70
60
50
40
30
20
10
0
Sklm (kg)
Pre
Post
Follow up
Timeline
Yoga Sklm-
Control Sklm-
Fat Free Mass
Mean ± SD
70
60
50
40
30
20
10
0
Ffm (kg)
Pre
Post
Follow up
Timeline
Yoga ffm-
Control ffm-

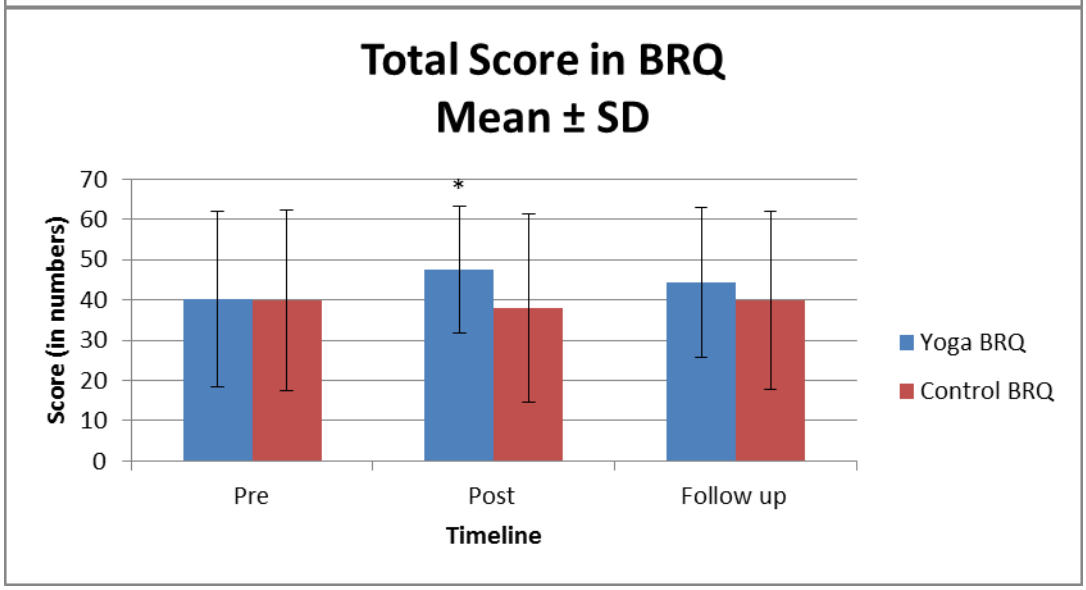
PSYCHOLOGICAL PARAMETERS:






Total Score in PSQI
Mean ± SD
Score (in numbers)
10
8
6
4
2
0
*
Pre
Post
Follow up
Timeline
Yoga PSQI
Control PSQI


Total Score in MAAS
Mean ± SD
Score (in numbers)
6
5
4
3
2
1
0
Pre
Post
Follow up
Timeline
Yoga MAAS
Control MAAS


Total Score in BRQ
Mean ± SD
Score (in numbers)
70
60
50
40
30
20
10
0
*
Pre
Post
Follow up
Timeline
Yoga BRQ
Control BRQ

APPENDIX 3 INFORMED CONSENT FORM

S-VYASA Deemed University
Swami Vivekananda Yoga Anusandhana Samsthana
Deemed University u/S of 3 of the UGC Act, 1956

INFORMED CONSENT FORM for the study titled Effect of Integrated Approach of Yoga therapy on Over-weight and Obesity

Dr. NIDHI (CHOUDHARY) RAM

Principal Investigator

Sub:- Informed Consent Form for persons having overweight/obesity, participating in the study titled " Effect of IAYT (Integrated Approach of Yoga Therapy) on overweight/ obesity", organized by Swami Vivekananda Yoga Anusandhana Samsthana (SVYASA Yoga University) Bangalore.

Name of Organization: **Swami Vivekananda Yoga Anusandhana Samsthana (SVYASA Yoga University) Bangalore.**

Name of Program Director: Dr. Subramanya Pailoor

Name of Program: PhD Yoga

This Informed Consent Form has two parts:

- **Information Sheet (to share information about the research with you)**
- **Certificate of Consent (for signatures if you agree to take part)**

You will be given a copy of the full Informed Consent Form.

PART I: Information Sheet

Introduction:-

We are from Swami Vivekananda Yoga Anusandhana Samsthana (SVYASA Yoga University), Bangalore, and doing a research study on Overweight/Obesity.

We wish to give you further information and invite you to be part of this research. You do not have to decide today whether or not you will participate in the research. Before you decide, you can talk to anyone you feel comfortable with about the research.

There may be some words that you do not understand in this form. Please feel free to ask any of the research staff present. Also you can ask questions/clarifications to me or our research staff now or later.

Over weight/Obesity epidemic is prevalent globally and it is a cause for many diseases. It is known there are 300 million obese people globally. Over-weight and obesity are leading risks for global deaths; around 3.4 million adults die each year as a result of being overweight or obese.

Overweight and central obesity and sedentary behaviour coexist with under nutrition, and is a public health problem in major cities in India including Mumbai. Study in Mumbai shows that in age group of 31 to 50 years obesity range is from 10 to 53 % in males. This is a major risk factor for many diseases such as diabetes, cancer, cardiovascular disease musculoskeletal disorders, respiratory disorders and obstructive sleep apnoea syndrome, etc. You will have a 50/50 chance (like flipping a coin) of being place in one of two groups. Neither the researcher nor you will make the choice, so that bias in the study is reduced. The two groups are (a) The Yoga Based Life Style Group and (b) The Control Group.

The Integrated Approach of Yoga Therapy (IAYT) is a holistic yoga package for overweight/obese persons with a yoga module consisting of simple physical postures (asana), breathing techniques (pranayama), relaxation and meditation techniques which will be introduced in a slow progressive manner.

There will be a phase of learning during these practices that would allow for participants to clarify doubts and correct their postures and practice. Each session of the intervention would last for 90 minutes and would be practiced for five days in a week for about 12 weeks. During the follow up phase you would be advised to continue the practice for another 12 weeks. That is total programme is of 24 weeks (6 months). The yoga group will do yoga practices like asana, pranayama,

suryanamaskara, meditation etc for one and half hours 5 days in a week. The control group will continue any alternative methods which they have been following eg walking/physical activities, in place of yoga intervention in the first 6 months. The control group will also get the yoga classes, but after 6 months in the study.

Purpose of the research

Obesity is a major health problem and is increasing worldwide. Obesity is risk factor for many serious diseases like diabetes, cancer, heart disease etc. In Indian cities such as Mumbai obesity problem is constantly increasing. Popular methods for controlling obesity are by diet, medicines or surgery etc. But these methods have their own complications/ side effects. Also the problem may reappear afterwards. Our study is to reduce obesity by the practice of a holistic yoga module. The effectiveness of this IAYT yoga programme will be tested in this study.

Type of Research Intervention

The Integrated Approach of Yoga Therapy (IAYT) consists of simple physical postures (asanas), breathing techniques (pranayama), relaxation and meditation techniques which will be introduced in a very slow progressive graded manner. This will be demonstrated in the class step by step. It is not required to have any prior knowledge on yoga, to participate.

Participant selection

This study is for overweight/obese adult males with a BMI from 23 to 35 kg/m^2 and age 18 to 60 years. This IAYT yoga programme is for primary as well secondary prevention from obesity/overweight. So if you are selected you will be taught IAYT in a phased manner, with individual attention. The study is to find out the effect of the IAYT on people having obesity/overweight. Hence various parameters will be measured during the study period of six months. There will not be any blood testing or any invasive methods for assessments. The selection will be by Randomized control Trial. **Voluntary Participation**

Please note that the participation is purely on voluntary basis. You may change your mind later and stop participating even if you agreed earlier.

Procedures and Protocol

1) Unfamiliar Procedures

Measurements/assessments of parameters for both yoga and control groups will be taken in the beginning (before starting), after 3 months and after 6 months of starting. The assessments will be carried out in the morning before breakfast between 8:00am to 10:00am.

Parameters/Assessments					
Sr No	Anthropometry	Body composition	Psychology	Life style	Medical case history
1	Body Weight	Body Fat Mass	Perceived stress scale	Diet log	Present illness
2	Body Mass Index(BMI)	Percentage body fat	International physical activity questionnaire	Exercise log	past illness
3	Mid Arm Circumference (MAC)	Skeletal muscle mass	Patient health questionnaire		Medication
4	Waist/Hip Ratio (WHR)	BMR	Acceptance and action questionnaire for weight difficulties		Family history of obesity
5	'A' Body Shape Index	Total body water	Mindful attention and awareness scale		Co-morbidities
6	Skin Fold Thickness	Fat free mass	Pittsburg sleep quality index		
7		Segmental muscle mass	BREQ-2(Behavioral Regulation in Exercise Questionnaire)		
8		Segmental fat mass	General health Questionnaire GHQ 12- for Inclusion		

Anthropometric parameters like body weight, waist circumference etc, body composition like body fat etc. using a bio impedance instrument, and psychological parameters using questionnaires will be measured.

Inclusion criteria specify that only individual with a BMI from 23 to 35 Kg/m^2 will be selected for the participation. (BMI 23 to 25 is Overweight and above 25 is Obese).Only male individuals above 18 years up to 70 years will be included. The measurements/assessments of parameters will be done after consent for participation is received. The measurements /assessments are as above in brief.

The above assessments /parameters will be taken from individual in one sitting only.

2) Description of the Process

The yoga group will do the yoga practices as below for 6 months.

Sr. No	Yoga Practice
1	Lecture & Counselling
2	Warm Up
3	*Surya Namaskara*
4	*Asana*
5	*Pranayama*
6	Meditation
	Total duration 90 minutes

Side Effects/risks:

There may be slight discomfort or uneasiness/fatigue etc while doing some of the dynamic practices. There is no known side effects, in doing yoga exactly as per the instructions. Yoga

practices would be introduced in a gentle and slow pace to help you relax. These practices will have no religious connotation nor affect the religious sentimentality of any participant. If you have any concerns about the risks or benefits of the intervention, you can contact the researcher at the numbers listed on the previous page. The assessments/measurements also don't have any side effects.

There will be general instructions, such as yoga should be done with empty stomach etc. These are to be followed. Please ask for clarifications if you are suffering with any specific disease or if you are taking some medicines.

In-case of Injury to the subject:

Although injury arising due blood draws or yoga postures are a very rare possibility, in case you are injured as a result of being in this study, you will be provided all the necessary treatment for injuries. You should contact the study staff or report to the clinical supervisor in the event of such claim.

Benefits:

If you participate in this research, obesity will be controlled/prevented. Your various parameters will be assessed and health condition will be known. You will be able to get benefits of yoga. Also you are helping the society by participating in research study to find solution to a global epidemic.

Reimbursements:

Participation is completely voluntary and no payment will be provided to the participants. **The investigations pertaining to the study will be free during the period of the study**. Any patient requiring any other form of therapy will be informed of the same however, no cost will be born for these from our end.

Confidentiality:

Information obtained in this study is strictly confidential unless disclosure is required by law. You will be assigned a research number, rather than your name, which will be recorded on the assessments you receive. All data will be secured in a locked filing cabinet. Your name will not be used in the reporting of information in publications or presentations.

Right to Refuse or Withdraw:

You have the right to refuse to participate in this study, the right to withdraw from the study and the right to have your data destroyed at any point during or after the study, without penalty, except in situations that violate state and/or federal law and regulations.

Whom to Contact

If you have any questions you may ask them now or later, even after the study has started. If you wish to ask questions later, you may contact any of the following:

P B Rshikesan, 10-B, Udayagiri Anushaktinagar Mumbai 400094 Tel: 09969666897. Email hrishipb@gmail.com

This proposal has been reviewed and approved by IEC, SVYASA Yoga University, Bangalore, which is a committee whose task it is to make sure that research participants are protected from harm. If you wish to find about more about the IEC, contact- P B Rshikesan, Yoga (PhD) 3rd Semester SVYASA Bangalore-Local address: 10-B, Udayagiri Anushaktinagar Mumbai 400094 Tel: 09969666897.

PART II: CERTIFICATE OF CONSENT

I have read the foregoing information. I have had the opportunity to ask questions about it and any questions that I have asked have been answered to my satisfaction. I consent voluntarily to participate as a participant in this research.

Name of Participant_____

Signature of Participant _____

Date _____

Day/month/year

Statement by the researcher/person taking consent:-

I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands that the following will be done:

1. Participate in the research as either in yoga group or control group and will give assessment/measurements as specified.
2. If in yoga group participant will do the IAYT practices also.

I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

A copy of this ICF has been provided to the participant.

Name of **Researcher**/person taking the consent **P B RSHIKESAN**

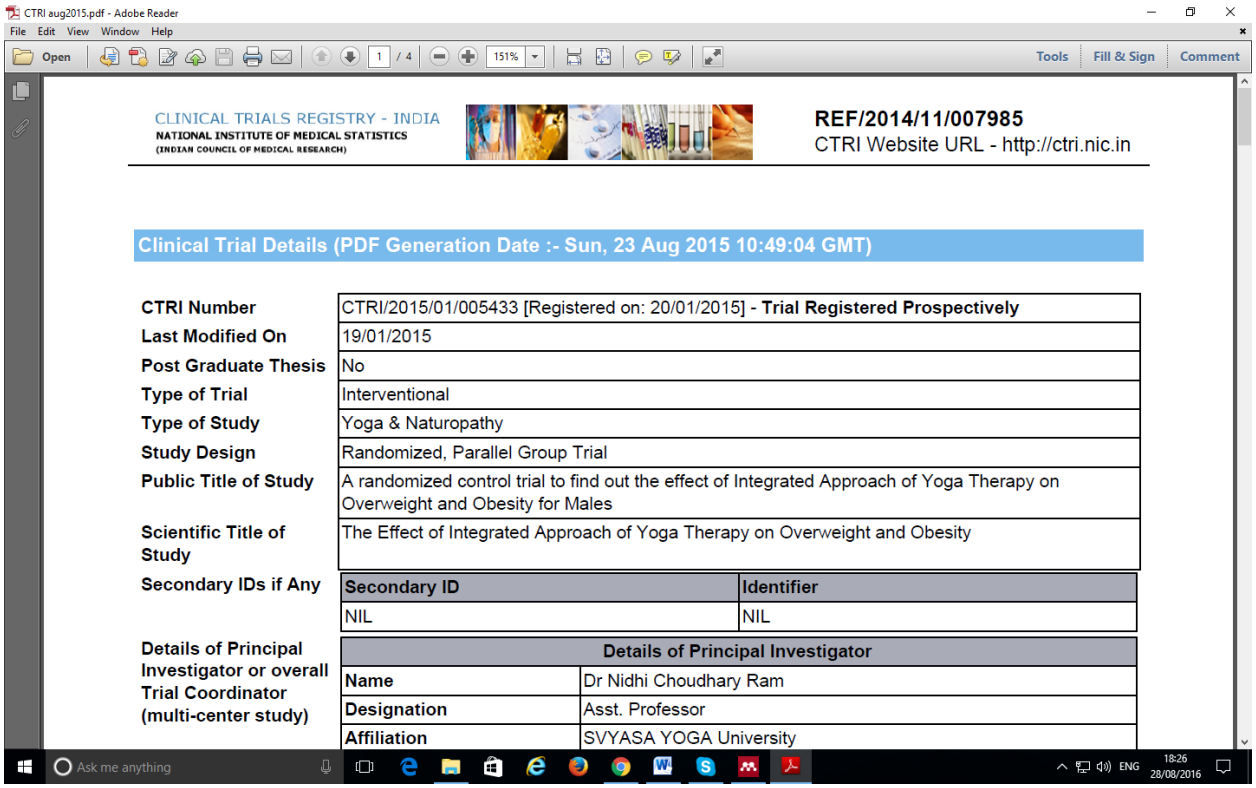
Signature of **Researcher** /person taking the consent_____

Date _____

Day/month/year

APPENDIX 4 CLINICAL TRIAL REGISTRATION

CTRI REGISTRATION:



CTRI aug2015.pdf - Adobe Reader

CLINICAL TRIALS REGISTRY - INDIA
NATIONAL INSTITUTE OF MEDICAL STATISTICS
(INDIAN COUNCIL OF MEDICAL RESEARCH)

REF/2014/11/007985
CTRI Website URL - http://ctri.nic.in

Clinical Trial Details (PDF Generation Date :- Sun, 23 Aug 2015 10:49:04 GMT)

CTRI Number	CTRI/2015/01/005433 [Registered on: 20/01/2015] - **Trial Registered Prospectively**
Last Modified On	19/01/2015
Post Graduate Thesis	No
Type of Trial	Interventional
Type of Study	Yoga & Naturopathy
Study Design	Randomized, Parallel Group Trial
Public Title of Study	A randomized control trial to find out the effect of Integrated Approach of Yoga Therapy on Overweight and Obesity for Males
Scientific Title of Study	The Effect of Integrated Approach of Yoga Therapy on Overweight and Obesity

Secondary IDs if Any	**Secondary ID**	**Identifier**
	NIL	NIL

Details of Principal Investigator or overall Trial Coordinator (multi-center study)	**Details of Principal Investigator**	
	Name	Dr Nidhi Choudhary Ram
	Designation	Asst. Professor
	Affiliation	SVYASA YOGA University

APPENDIX 5 IEC

स्वामी विवेकानन्द योग अनुसंधान संस्थान

Swami Vivekananda Yoga Anusandhāna Samsthāna

(Declared as Deemed-to-be University under Section 3 of the UGC Act, 1956)

Eknath Bhavan, # 19, Gavipuram Circle, Kempegowda Nagar, Bangalore - 560 019

Ph: 080 - 2661 2669, Telefax: 080 - 2660 8645

E-mail: svyasa@svyasa.org Website: www.svyasa.org

RES/IEC-SVYASA/41/2014 October 31, 2014

To,
Dr. Nidhi (Choudhary) Ram
Assistant Professor,
S-VYASA Yoga University,
Bangalore

Reference:

"Effect of Integrated Approach of Yoga Therapy (IAYT) on overweight and obesity'."- Committee Approval of the above mentioned study

Dear Dr. Nidhi (Choudhary) Ram,
We have received from you the following study related documents vide your letter dated September 18, 2014

1	Project Proposal
2	Informed consent form

Ethics committee meeting was held on October 19, 2014 at 10 am to 1:00 pm at Eknath Bhavan, Bangalore. Above documents were examined and discussed in the meeting. After due consideration, the committee has decided to approve conducting the aforementioned study.

APPROVED
INSTITUTIONAL ETHICS COMMITTEE
SVYASA, BANGALORE

स्वामी विवेकानन्द योग अनुसंधान संस्थान
Swami Vivekananda Yoga Anusandhāna Samsthāna
(Declared as Deemed-to-be University under Section 3 of the UGC Act, 1956)
Eknath Bhavan, # 19, Gavipuram Circle, Kempegowda Nagar, Bangalore - 560 019
Ph: 080 - 2661 2669, Telefax: 080 - 2660 8645
E-mail: svyasa@svyasa.org Website: www.svyasa.org

This is to confirm that neither Dr. Nidhi (Choudhary) Ram nor any study staff participating in this study were involved in the voting procedures and decision making.

The institutional Review Board / Independent Ethics Committee (IEC) are expected to be informed about the progress of the study / any changes in the protocol and patient information / informed consent. The investigators are also expected to submit a copy of the final report to IEC for records.

This approval is valid up to the completion of the study at the site.

Please submit to the IEC, the status report of the study as per the SOPs.

The IEC is organized & operates according to the requirements of ICH – GCP, Indian Council of Medical Research guidelines & Schedule Y.

Best Wishes,

R.S. Venkatesh,
Member Secretary,
Institutional Ethics Committee,
S-VYASA, Bangalore.

APPENDIX 6 QUESTIONNAIRES USED

ANNEXURE – 1 PSS

PERCEIVED STRESS SCALE

The questions in this scale ask you about your feelings and thoughts during the last month. In each case, you will be asked to indicate by circling *how often* you felt or thought a certain way.

Name :_____Date : _____

Age : _____ (Gender (Circle) : **M**

0 = Never 1 = Almost Never 2 = Sometimes 3 = Fairly Often 4 = Very Often

1	In the last month, how often have you been upset because of something that happened unexpectedly?.....	**0**	**1**	**2**	**3**	**4**
2	In the last month, how often have you felt that you were unable to control the important things in your life ?	**0**	**1**	**2**	**3**	**4**
3	In the last month, how often have you felt nervous and "stressed"?	**0**	**1**	**2**	**3**	**4**
4	In the last month, how often have you felt confident about your ability to handle your personal problems?.	**0**	**1**	**2**	**3**	**4**
5	In the last month, how often have you felt that things were going your way?.	**0**	**1**	**2**	**3**	**4**
6	In the last month, how often have you found that you could not cope with all the things that you had to do? .	**0**	**1**	**2**	**3**	**4**
7	In the last month, how often have you been able to control irritations in your life?.	**0**	**1**	**2**	**3**	**4**
8	In the last month, how often have you felt that you were on top of things?	**0**	**1**	**2**	**3**	**4**
9	In the last month, how often have you been angered because of things that were outside of your control?	**0**	**1**	**2**	**3**	**4**
10	In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?..	**0**	**1**	**2**	**3**	**4**

ANNEXURE – 2 IPAQ

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE (IPAQ)

The International Physical Activity Questionnaires (IPAQ) comprises a set of 4 questionnaires. Long (5 activity domains asked independently) and short (4 generic items) versions for use by either telephone or self-administered methods are available. The purpose of the questionnaires is to provide common instruments that can be used to obtain internationally comparable data on health- related physical activity.

Questionnaire Sample Page

1a. During the last 7 days, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling,?

Think about *only* those physical activities that you did for at least 10 minutes at a time.

_____ days per week. _____ None

1b. How much time in total did you usually spend on one of those days doing vigorous physical activities ?

_____ Hours_____Minutes _____ None

2a. Again, think *only* about those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

_____ days per week. _____ None

2b. How much time in total did you usually spend on one of those days doing moderate physical activities ?

_____ Hours_____Minutes _____ None

3a. During the last 7days, on how many days did you **walk** for at least 10 minutes at a time? This includes walking at work and at home, walking to travel from place to place, and any other walking that you did solely for recreation, sport, exercise or leisure.

_____ days per week. _____ None

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE (IPAQ)

3b. How much time in total did you usually spend walking on one of those days ?

_____ Hours_____Minutes _____ None

The last question is about the time you spent sitting on weekdays while at work, at home, while doing course work and during leisure time. This includes time spent sitting at a desk, visiting friends, reading traveling on a bus or sitting or lying down to watch television**.**

4a During the last 7 days, how much time in total did you usually spend *sitting* on week day ?

_____ Hours_____Minutes _____ None

This is the end of questionnaire, thank you for participating.

ANNEXURE – 3

REGISTRATION SHEET

NAME: ……..…… Age :…… Sex: M ☐

ADDRESS : ……..……Date of Birth: ……..…..…….

Other relevant details/diseases if any:

Occupation: ……..……...…….

PHONE:……

E Mail: ……..……

ANNEXURE – 4 PHQ

PATIENTS HEALTH QUESTIONNAIRE

Over the last 8 weeks, how often have you been bothered by any of the following problems? *(Use "✔" to indicate your answer)*	**Not at all**	**Several days**	**More than half the days**	**Nearly every day**
1. Little interest or pleasure in doing things	0	1	2	3
2. Feeling down, depressed, or hopeless	0	1	2	3
3. Trouble falling or staying asleep, or sleeping too much	0	1	2	3
4. Feeling tired or having little energy	0	1	2	3
5. Poor appetite or overeating	0	1	2	3
6. Feeling bad about yourself — or that you are a failure or have let yourself or your family down	0	1	2	3
7. Trouble concentrating on things, such as reading the newspaper or watching television	0	1	2	3
8. Moving or speaking so slowly that other people could have noticed? Or the opposite — being so fidgety or restless that you have been moving around a lot more than usual	0	1	2	3
9. Thoughts that you would be better off dead or of hurting yourself in some way	0	1	2	3

ANNEXURE – 4 CONTD….

If you checked off any problems, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people.

Not difficult at all	Somewhat difficult	Very Difficult	Extremely Difficult

ANNEXURE-5 AAQ-W

AAQ-W(Acceptance and Action Questionnaire for Weight-Related Difficulties**)**

A) **Below you will find a list of statements.** ***Please rate the truth of each statement as it applies to you.*** **Use the following scale to make your choice.**

1 2 3 4 5 6 7
Never True Always True

1 2 3 4 5 6 7	1. It's OK to feel fat
1 2 3 4 5 6 7	2. When I have negative feelings, I use food to make myself feel better
1 2 3 4 5 6 7	3. I try to suppress thoughts and feelings that I don't like about my body or weight by just not thinking them
1 2 3 4 5 6 7	4. I am not in control of what I eat
1 2 3 4 5 6 7	5. I try hard to avoid feeling bad about my weight or how I look
1 2 3 4 5 6 7	6. I am in control of how much physical activity I do
1 2 3 4 5 6 7	7. When I evaluate my weight or my appearance negatively, I am able to recognize that this is just a reaction, not an objective fact.
1 2 3 4 5 6 7	8. In order to eat well and do physical activity, I need to feel like it
1 2 3 4 5 6 7	9. I need to feel better about how I look in order to live the life I want to
1 2 3 4 5 6 7	10. Other people make it hard for me to accept myself

B) For each question, please circle a number from 1 through 7.

1	2	3	4	5	6	7	
Not at all believable						Completely believable	
1	2	3	4	5	6	7	11. If I'm overweight, I can't live the life I want to
1	2	3	4	5	6	7	12. If I feel unattractive, there is no point in trying to be intimate
1	2	3	4	5	6	7	13. If I gain weight, that means I have failed
1	2	3	4	5	6	7	14. I'm in control of my eating behavior
1	2	3	4	5	6	7	15. I don't have what it takes to be healthy for life
1	2	3	4	5	6	7	16. My eating urges control me
1	2	3	4	5	6	7	17. I need to get rid of my eating urges to eat better
1	2	3	4	5	6	7	18. I am a stable person
1	2	3	4	5	6	7	19. If I eat something bad, the whole day is a waste
1	2	3	4	5	6	7	20. I should be ashamed of my body
1	2	3	4	5	6	7	21. I need to avoid social situations where people might judge me

1 2 3 4 5 6 7 22. I will always be overweight

Note:-

Before a sum score is taken, items 1, 6, 7, 14, and 18 are reversed keyed: Lower scores indicate less experiential avoidance and more psychological flexibility. The range of possible scores is 22 to 154. Because it can be confusing to speak of a lower score reflecting "more psychological flexibility" the scoring can be changed if the clinician or user is conceptually focused on increasing acceptance and response flexibility. In this case, items 1, 6, 7, 14, and 18 would be scored as normally and all other items would be reverse scored.

ANNEXURE-6- MAAS

The MAAS (mindful attention awareness scale) is a 15-item scale designed to assess a core characteristic of dispositional mindfulness, namely, open or receptive awareness of and attention to what is taking place in the present. The scale shows strong psychometric properties and has been validated with college, community, and cancer patient samples. Co relational, quasi-experimental, and laboratory studies have shown that the MAAS taps a unique quality of consciousness that is related to, and predictive of, a variety of self-regulation and well-being constructs. The measure takes 10 minutes or less to complete.

Day-to-Day Experiences:-

Instructions: Below is a collection of statements about your everyday experience. Using the 1-6 scale below, please indicate how frequently or infrequently you currently have each experience.

Please answer according to what really reflects your experience rather than what you think your experience should be. Please treat each item separately from every other item.

1 Almost always

2 very frequently

3 Somewhat Frequently

4 Somewhat infrequently

5 Very Infrequently

6 Almost never

I could be experiencing some emotion and not be conscious of it until some time later.	1	2	3	4	5	6
I break or spill things because of carelessness, not paying attention, or thinking of something else.	1	2	3	4	5	6

I find it difficult to stay focused on what's happening in the present.	1	2	3	4	5	6
I tend to walk quickly to get where I'm going without paying attention to what I experience along the way.	1	2	3	4	5	6
I tend not to notice feelings of physical tension or discomfort until they really grab my attention.	1	2	3	4	5	6
I forget a person's name almost as soon as I've been told it for the first time	1	2	3	4	5	6
It seems I am "running on automatic," without much awareness of what I'm doing.	1	2	3	4	5	6
I rush through activities without being really attentive to them.	1	2	3	4	5	6
I get so focused on the goal I want to achieve that I lose touch with what I'm doing right now to get there.	1	2	3	4	5	6
I do jobs or tasks automatically, without being aware of what I'm doing.	1	2	3	4	5	6
I find myself listening to someone with one ear, doing Something else at the same time.	1	2	3	4	5	6
I drive places on "automatic pilot" and then wonder why I went there.	1	2	3	4	5	6
I find myself preoccupied with the future or the past.	1	2	3	4	5	6
I find myself doing things without paying attention.	1	2	3	4	5	6
I snack without being aware that I'm eating.	1	2	3	4	5	6

Scoring information:

To score the scale, simply compute a mean of the 15 items. Higher scores reflect higher levels of dispositional mindfulness.

ANNEXURE-7 PSQI

AM

Subject's Initials_____ID#_____Date _____

_____Time_____PM

PSQI (PITTSBURGH SLEEP QUALITY INDEX)

INSTRUCTIONS:

The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions.

1. During the past month, what time have you usually gone to bed at night?

BED TIME _____

2. During the past month, how long (in minutes) has it usually taken you to fall asleep each night?

NUMBER OF MINUTES _____

3. During the past month, what time have you usually gotten up in the morning?

GETTING UP TIME _____

4. During the past month, how many hours of actual sleep did you get at night? (This may be different than the number of hours you spent in bed.)

HOURS OF SLEEP PER NIGHT _____

For each of the remaining questions, check the one best response. Please answer all questions.

5. During the past month, how often have you had trouble sleeping because you . . .

a) Cannot get to sleep within 30 minutes

Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
___	___	___	___

b) Wake up in the middle of the night or early morning

Not during the past month ___ Less than once a week ___ Once or twice a week ___ Three or more times a week ___

c) Have to get up to use the bathroom

Not during the past month ___ Less than once a week ___ Once or twice a week ___ Three or more times a week ___

d) Cannot breathe comfortably

Not during the past month ___ Less than once a week ___ Once or twice a week ___ Three or more times a week ___

e) Cough or snore loudly

Not during the past month ___ Less than once a week ___ Once or twice a week ___ Three or more times a week ___

f) Feel too cold

Not during the past month ___ Less than once a week ___ Once or twice a week ___ Three or more times a week ___

g) Feel too hot

Not during the past month ___ Less than once a week ___ Once or twice a week ___ Three or more times a week ___

h) Had bad dreams

Not during the past month ___ Less than once a week ___ Once or twice a week ___ Three or more times a week ___

i) Have pain

Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
___	___	___	___

j) Other reason(s), Please describe _____

How often during the past month have you had trouble sleeping because of this?

Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
___	___	___	___

6. During the past month, how would you rate your sleep quality overall?

Very good _____

Fairly good _____

Fairly bad _____

Very bad _____

7. During the past month, how often have you taken medicine to help you sleep (prescribed or "over the counter")?

Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
___	___	___	___

8. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?

Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
___	___	___	___

9. During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?

No problem at all _____

Only a very slight _____

problem Somewhat of a _____

problem

A very big problem _____

10. Do you have a bed partner or room mate?

No bed partner or room mate _____

Partner/room mate in other room _____

Partner in same room, but not same bed _____

Partner in same bed _____

If you have a room mate or bed partner, ask him/her how often in the past month you have had . . .

a) Loud Snoring

Not during the past month ___ Less than once a week ___ Once or twice a week ___ Three or more times a week ___

b) Long pauses between breathes while asleep

Not during the past month ___ Less than once a week ___ Once or twice a week ___ Three or more times a week ___

c) Legs twitching or jerking while you sleep

Not during the past month ___ Less than once a week ___ Once or twice a week ___ Three or more times a week ___

d) Episodes of disorientation or confusion during sleep

Not during the past month ___ Less than once a week ___ Once or twice a week ___ Three or more times a week ___

e) Other restlessness while you sleep; please describe

Not during the past month ___ Less than once a week ___ Once or twice a week ___ Three or more times a week ___

ANNEXURE 8 SUGGESTED DIET PLAN

SUGGESTED DIET PLAN FOR SUBJECTS

A balanced diet (National Institution of Nutrition, 2011) provides all the nutrients in required amounts and proper proportions and a balanced diet should provide around 50-60% of total calories from carbohydrates, preferably from complex carbo-hydrates, about 10-15% from proteins and 20- 30% from both visible and invisible fat. In addition, a balanced diet should provide other non- nutrients such as dietary fibre, antioxidants and phytochemicals which give positive health benefits. Antioxidants such as vitamins C and E, beta-carotene, riboflavin and selenium protect the human body from free radical damage.

Spices like turmeric, ginger, garlic, cumin and cloves are rich in antioxidants. It is suggested to consume fresh, locally available seasonal vegetables and fruits. There is no single dietary regimen for weight reduction; it has to be individualized. Hence only a general suggestion is given to the subjects and there is no strict dietary control feasible.

BALANCED DIET FOR ADULTS-SEDENTARY/MODERATE/HEAVY ACTIVITY

SAMPLE MEAL PLAN FOR ADULT MAN (SEDENTARY)

A BREAK UP OF TYPICAL MEAL & ITS CALORIE VALUES FOR ADULT MAN (SEDENTARY) - FOR REFERENCE

Sr No	Meal time	Food Group	Raw	Cooked Recipe	Serving Amounts	k cal. approx.
1	Break fast(approx 500 k cal)	Milk	100ml	milk or	1/2 cup	~90
		Sugar	15gm	tea or	2 cup	~150
				coffee	1 cup	~110
		Cereals	70gm	break fast item	Ref note	~400
		Pulses	20gm			
2	Lunch(850 kcal approx)	Cereals	120gm	Rice	2 Cups	~340
				Pulkas	2 nos	~160
		Pulses	20gm	Dal	1/2 cup	~100
		Vegetables	150gm	Veg Curry	3/4 cup	~150
		Vegetables	50gm	Veg salad	7-8 slices	~50
		Milk	100ml	Curd(no sugar)	1/2 cup	~50
3	Tea ,Snack(175 kcal approx)	Cereals	50gm	Snack	Refer note	~100(if biscuit only –ref note)
		Milk	50ml	Tea	1 Cup	~75
		Sugar	10gm			
4	Dinner(855 kcal approx)	Cereals	120gm	Rice	2 Cups	~340
				Pulkas	2 Nos	~160
		Pulses	20gm	Dal/Sambhar	1/2 cup	~100
		Vegitables	150gm	Veg Currey	3/4 cup	~130(1 cup 170)
		Milk(or Curd)	50ml			~50
		vegetables	50gm			~25
		Fruit	100gm	Seasonal	1 Medium	~50(banana kcal .will be 90)

Note:- 1 Cup is 200ml

For Non Vegetarian food –please refer Substitute one pulse portion with one portion of egg/meat/chicken/fish. (or refer the **table attached**)
Use 35 gm visible fat per day.

Break fast item- Idli 4 nos/Dosa -3 nos/Upma -One and half Cup/Bread -4 slices/Porridge -2 Cup/Corn Flakes with milk 2 Cups.

Snacks- Poha 1 Cup(270 kcal) / Toast 2 slices(>170kcal) / Samosa 2 (400k cal) / Sand wiches 2(>340 kcal) / Biscuits 5(>100 kcal plain less calorie biscuit)

For Ref on kcal of non veg items:-

Sr No	Item	Quantity	Approx k cal
1	Boiled Egg	1 no	90
2	Omlette	1 no	160
3	Fried egg	1 no	160
4	Mutton curry	¾ cup	260
5	Chicken curry	¾ cup	240
6	Fish fried	2 big pieces	190
7	Fish cutlet	2no	190
8	Prawn curry	¾ cup	220
9	Keema kofta curry	¾ cup(6 small koftas)	240

-The daily diet to have an energy deficit of about 300 kcal/ day in general. This can be achieved by decreasing cereal based item at every meal.

APPENDIX 7 INTERVENTION DETAILS

INTEGRATED APPROACH OF
YOGA THERAPY (IAYT) ON OBESITY

THE FIVE PART DAILY (Five DAYS A WEEK) IAYT INTERVENTION DETAILS		
Sr No	**Yoga Practice**	**Duration (minutes)**
1	Lecture & Counseling	10
2	Warm Up	10
3	*Surya Namaskara*	10
4	*Asana*	30
5	*Pranayama*	15
6	Meditation	15
	Total duration	**90**

SR NO	YOGA PRACTICES	TIME MINUTES	TOTAL YOGA INTERVENTION DURATION INCLUDING ALL FIVE PARTS
PART-1	**LECTURE COUNSELLING AND WARM UP**		
	LECTURE AND COUNSELLING First Ten minutes of the sessions of lectures focused on following aspects		
1	Concepts of awareness according to yogic texts: *Pranadharana* & Differential relaxation		
2	Concept of yoga and health-*Mithahar*		
3	Scriptural basis of yoga therapy		
4	Definition of yoga as mind mastery		
5	Techniques of yogic limbs for therapy		
6	*Āsanas* for mind mastery		
7	*Prāṇayama* for mind mastery		
8	Meditation for mind mastery		
9	Yogic diet for mind mastery		
10	Yogic counseling using *Yama, Niyama and also Karma yoga Jnana yoga and Bhakti yoga* for mind Mastery.		
	WARM UP		
1	Jogging forward, Backward, Sideward and *Mukha Dhauti*	TOTAL 10 Minutes for warm up (10 items per day, 1 minute for each item. The items repeated every third day)	Total 90 Minutes for all five Parts. All yoga practices taught progressively in steps.
2	Forward Backward Bending		
3	Side Bending		
4	Spinal twist- legs apart		
5	Alternate leg touching		
6	Sit in Standing Position		
7	Hip Twist		
8	Knee rotation		
9	Back Swing		
10	Hip Stretch		
11	Knee Stretch		
12	*Pawanamuktasana* Stretch		
13	Cycling		
14	*Paschimatanasanana* stretch		
15	Dorsal Stretch		
16	Side Leg raising		
18	*Naukasana Stretch*		
19	*Pawanamuktasana Kriya*		
20	Rocking and Rolling		
21	*Halasanan Paschimatanasana* stretch	TOTAL 20 Minutes for part 1 items ie lecture, counseling & warm up.	Total 90 Minutes for Five Parts. All yoga practices taught progressively in steps
22	Straight leg raising		
23	Back Stretch(Single & Both)		
24	*Dhanurasana* Swing		
25	Alternate *Bhujamgasana Parvatasanana*		
26	Alternate *Bhujangasana Shalabhasana*		
27	Spinal Stretch		
28	*Bhunamana* stretch		
29	Butterfly *Kriya*		
30	*Chakkichalana* stretch		

31	Tiger stretch		

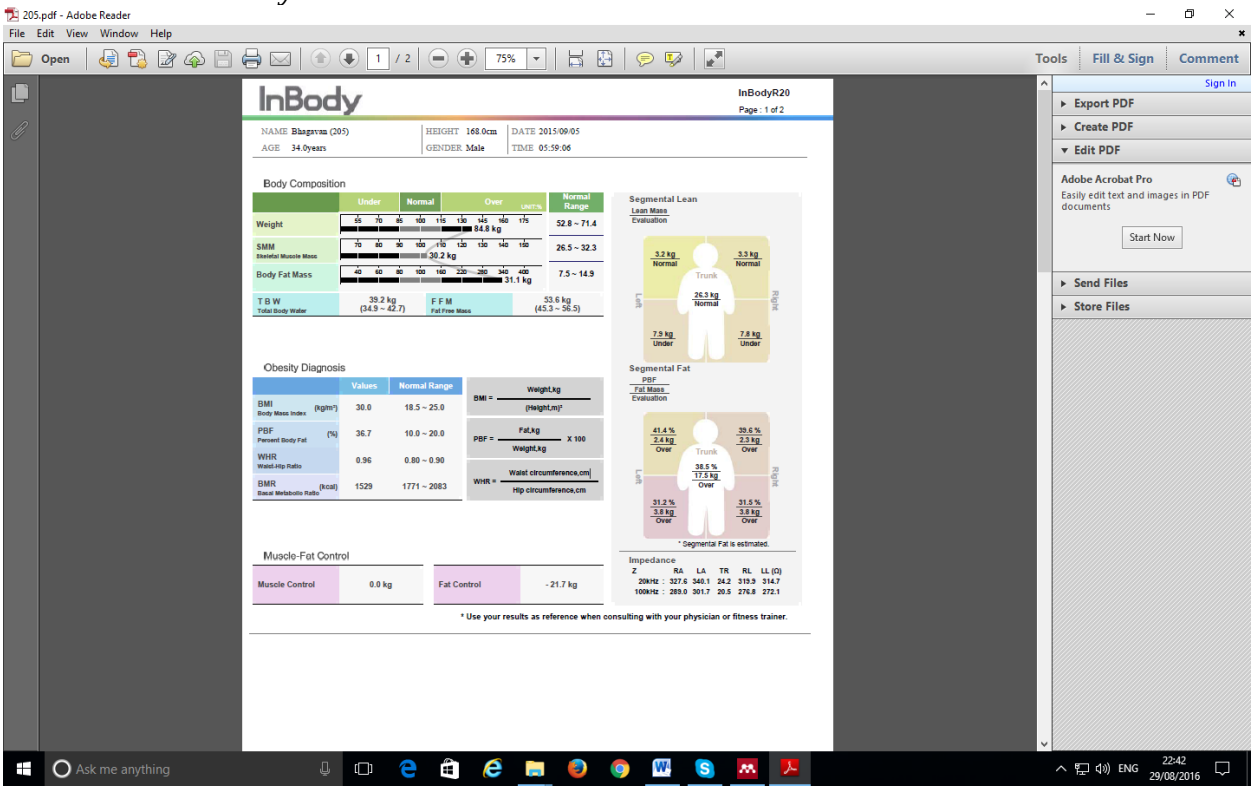
PART-2	*SURYA NAMASKARA*		
1	*Surya Namaskara* (12 step)	EVERY DAY Ten Minutes	Total 90 Minutes for all five Parts. All yoga practices taught progressively in steps

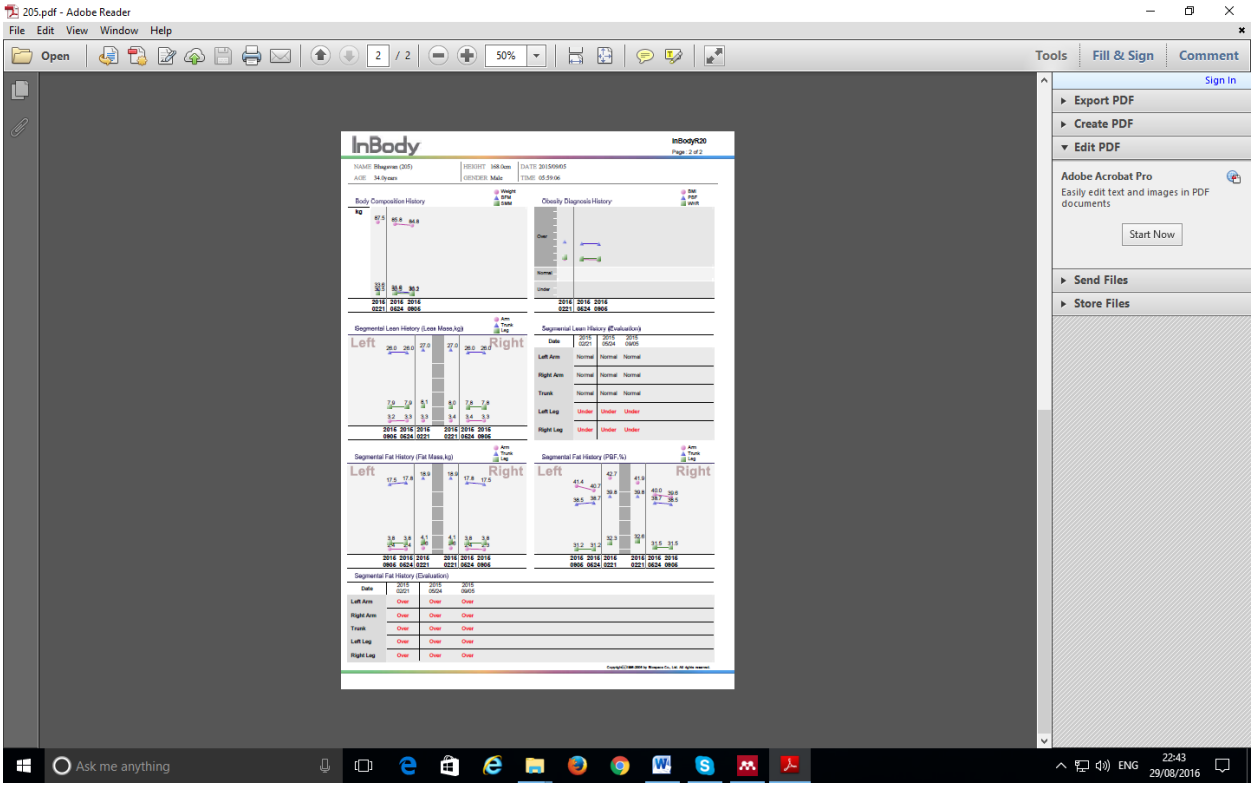
PART 3	*ASANAS*		
1	*Artha Kati Chakrasana*	TOTAL 30 Minutes Every Day ten items as per capacity	Total 90 Minutes for all five Parts. All yoga practices taught progressively in steps
2	*Artha Chakrasana*		
3	*Padahastasana*		
4	*Trikonasana*		
5	*Parivartitha Trikonasana*		
6	*Veerabhadrasana*		
7	*Prasaritha Padothanansana*		
8	*Natarajasana*		
9	*Garudasana*		
10	*Ekapadasana*		
11	*Parswa konasana*		
12	*Vakrasana –Sitting*		
13	*Artha Matsendrasana*		
14	*Ushtrasana*		
15	*Janu Shirasana*		
16	*Paschima tanasana*		
17	*Chakkichalanasana*		
18	*Gomuhasana*		
19	*Baddhakonasana*		
20	*Upavishta konasana*		
21	*Parivarthitha Janushirasana*		
22	*Marichasana*		
23	*Supta vajrasana*		
24	*Bhujangasana*		
25	*Shalabhasana*		
26	*Dhanurasana*		
27	*Parvathasana*		
28	*Sarpasana*		
29	*Chattura Dandasana*		
30	*Adhomukha swanasana*		
31	*Naukasana Supine*		
32	*Sarvangasana*		
33	*Matsyasana*		
34	*Hastasana*		
35	*Chakrasana*		
36	*Hasta pada amgushtasana*		
37	*Sethubandhasana*		
38	*Uthanapadasana*		
39	*Jataraparivarthasana*		
40	*Viparithakarani*		

PART 4	*PRANAYAMA*		
1	*Surya Anuloma Viloma*	TOTAL 15 Minutes. Every Day all items as per capacity	Total 90 Minutes for all five Parts. All yoga practices taught progressively in steps
2	*Nadishudhi*		
3	*Ujjayi*		
4	*Bhramari*		
5	*Bhastrika*		
6	*Vibhagiya Pranayama*		
7	Cooling *Pranayama*		

PART 5	MEDITATION		
1	'OM' Meditation	Total 15 Minutes- on different days	Total 90 Minutes for all five Parts. All yoga practices taught progressively in steps
2	Cyclic Meditation		
3	MSRT		
4	*Savasana*		

APPENDIX 8 InBody R20 OUTPUT TYPICAL FORMAT





APPENDIX 9 LIST OF PUBLICATIONS FROM THIS DOCTORAL THESIS

1) Rshikesan, P. B., & Subramanya, P. (2016). Effect of Integrated Approach of Yoga Therapy on Male Obesity and Psychological Parameters-A Randomised Controlled Trial. *Journal of Clinical and Diagnostic Research : JCDR*, *10*(10), KC01–KC06. http://doi.org/10.7860/JCDR/2016/21494.8727

2) Rshikesan, P. B., Subramanya, P., & Nidhi, R. (2016). Yoga Practice for Reducing the Male Obesity and Weight Related Psychological Difficulties-A Randomized Controlled Trial. *Journal of Clinical and Diagnostic Research : JCDR*, *10*(11), OC22–OC28. http://doi.org/10.7860/JCDR/2016/22720.8940

3) Rshikesan, P. B., Subramanya, P., & Nidhi, R. (2017). Yoga Practice to Improve Sleep Quality and Body Composition Parameters of Obese Male - a Randomized Controlled Trial. *Journal of Integrative and Complimentary Medicine*, UNDER REVIEW

4) Rshikesan, P. B., Subramanya, P., & Singh Deepeshwar, (2017). Sleep Quality and Body Composition Variations in Obese Male Adults after Fourteen weeks of Yoga Intervention- a Randomized Controlled Trial. *International Journal of Yoga*,10(-)- ACCEPTED

5) Rshikesan, P. B., & Subramanya, P., (2017). Ancient yoga texts: understanding the attributes and associations of obesity. *AYU*,- UNDER REVIEW

APPENDIX 10 InBody R20

A subject is standing over the foot stand of InBody R20 for body composition assessment.

The InBody R20 connected to Computer through USB cable

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APPENDIX 11 TYPICAL RAW DATA

Typical Raw Data of the Yoga group is given below. The highlighted Sr. Numbers are the drop outs.

Sl. No.	Ref. No	Group No	Age	Ht	Wtr1	Wtr2	Wtr3	Maclr 1	Maclr 2	Maclr 3	Macrr 1	Macrr 2	Macrr 3
1	240	0	34	182.0	104.9	102.9	#N/A	32.0	34.0		32.0	33.0	
2	241	0	41	160.0	71.9	72.5	72.9	30.0	31.0	28.0	30.2	31.0	28.0
3	242	0	49	168.5	88.4	86.9	83.6	33.5	32.3	30.0	32.5	32.0	29.0
4	244	0	49	169.0	85.7	85.7	84.4	32.2	30.0	29.0	32.5	31.0	20.0
5	245	0	53	161.0	68.2	66.7	65.2	28.0	26.5	27.0	28.4	27.0	28.0
6	246	0	59	164.5	73.3	72.8	#N/A	29.0	29.0		28.0	29.0	
7	248	0	52	172.0	87.7	84.2	85.6	29.2	29.8	29.0	29.5	31.5	30.0
8	249	0	34	169.5	85.7	84.5	84.5	28.0	29.4	28.0	30.0	31.0	28.0
9	250	0	40	174.0	78.9	78.9	80.4	28.5	28.0	27.3	29.0	27.5	28.0
10	251	0	33	167.0	80.1	82.0	81.3	27.0	27.0	27.0	27.5	27.0	27.0
11	252	0	29	165.0	82.9	83.3	83.2	34.5	33.0	31.0	32.5	32.8	31.0
12	253	0	30	161.0	74.7	74.2	74.0	29.5	30.5	28.0	28.5	28.0	28.0
13	254	0	45	156.0	63.9	63.9	63.1	29.0	28.0	27.0	29.0	28.0	26.8
14	255	0	31	172.0	92.9	91.8	92.5	30.0	29.3	29.0	30.0	29.8	29.0
15	256	0	39	176.0	81.7	79.0	80.8	31.0	29.0	29.0	31.0	28.5	30.0
16	257	0	48	172.0	76.1	75.6	#N/A	26.5	27.5		27.0	27.5	
17	258	0	32	168.0	80.2	81.6	79.5	30.0	30.0	31.5	29.5	30.0	31.0
18	260	0	51	178.0	105.3	103.8	104.8	35.0	31.0	33.5	36.0	32.0	33.0
19	261	0	40	170.0	75.2	74.6	74.0	28.0	29.0	27.0	28.0	30.0	27.5
20	262	0	40	169.0	99.6	99.7	75.0	33.0	33.0	28.0	33.5	33.5	28.0
21	263	0	31	174.0	76.7	75.1	76.1	28.0	26.0	26.5	27.0	25.0	27.0
22	264	0	44	167.0	79.0	80.2	76.7	27.0	28.3	26.0	27.0	27.5	26.0
23	265	0	33	158.5	68.9	68.8	69.5	29.0	31.0	26.0	29.0	29.6	28.0
24	266	0	32	175.0	85.1	85.0	85.0	30.0	29.5	28.0	31.0	30.0	29.0
25	267	0	49	180.0	92.7	89.6	86.7	31.0	28.5	27.0	31.0	28.5	26.5
26	268	0	37	157.0	67.9	68.4	68.2	29.5	28.8	27.0	30.2	30.5	28.0
27	269	0	40	168.0	84.2	74.9	75.3	31.0	29.5	28.5	33.0	30.3	29.5
28	270	0	32	182.0	88.9	90.1	90.7	30.5	31.0	29.0	30.0	31.0	30.0
29	271	0	36	183.5	94.4	93.6	94.5	31.0	31.0	29.0	30.0	31.0	30.0
30	272	0	49	173.0	98.2	96.1	92.1	33.1	31.8	30.0	33.8	32.2	30.0
31	273	0	51	160.0	72.4	68.9	69.7	28.5	29.5	27.0	29.5	28.5	27.0
32	274	0	31	178.0	85.9	84.4	82.6	30.0	29.0	28.0	30.0	30.0	27.5
33	275	0	26	163.0	75.2	68.8	69.7	28.5	27.8	27.0	29.0	28.0	28.0
34	276	0	33	171.0	75.4	76.2	71.9	27.8	25.0	27.5	27.0	26.0	26.5
35	278	0	31	186.0	95.1	91.4	89.1	32.0	31.0	29.0	31.5	31.0	29.0
36	205	0	34	168.0	87.5	85.8	84.8	30.0	29.5	28.0	31.0	30.5	28.5
37	279	0	42	172.5	99.1	99.0	101.8	29.5	30.5	29.0	31.0	32.0	29.0
38	280	0	50	167.0	71.6	71.1	71.0	29.0	27.0	26.0	29.0	27.5	26.0
39	281	0	52	165.0	80.1	81.0	80.7	30.2	31.0	29.0	31.0	30.5	30.0
40	207	0	60	165.0	75.9	74.1	76.5	27.3	26.0	27.0	28.0	26.5	27.0

Sl. No.	Ref .No	Wcr1	Wcr2	Wcr3	Hipr 1	Hipr 2	Hipr 3	Rafr 1	Rafr 2	Rafr 3	Rabr 1	Rabr 2	Rabr 3
1	240	110.0	106.0		114.5	110.0		13.0	16.5		20.5	28.0	
2	241	98.0	98.5	28.0	98.5	97.0	95.0	20.4	13.2	17.0	21.0	18.5	20.9
3	242	99.0	96.0	29.0	110.0	107.0	102.0	15.1	17.9	12.1	25.7	22.6	14.3
4	244	102.0	102.5	20.0	105.5	101.0	98.0	26.8	12.7	13.5	26.3	15.3	18.9
5	245	96.1	89.5	28.0	100.0	96.0	94.5	21.0	15.0	9.2	23.0	13.4	14.4
6	246	99.0	94.0		98.0	98.0		10.2	12.2		20.0	16.6	
7	248	101.0	105.5	30.0	104.5	105.0	102.5	22.0	14.8	14.0	22.2	17.7	11.7
8	249	107.0	106.8	28.0	105.0	101.0	100.0	13.4	20.7	12.3	18.0	22.5	14.4
9	250	93.4	96.8	28.0	98.0	97.8	96.0	10.0	12.3	9.3	11.3	11.5	14.2
10	251	96.0	94.5	27.0	99.0	102.0	98.0	7.3	13.0	9.6	16.0	14.4	12.6
11	252	98.0	97.0	31.0	101.0	102.0	101.5	22.0	16.1	13.7	19.0	30.2	19.0
12	253	90.0	89.0	28.0	98.0	99.5	97.0	10.0	9.4	16.1	21.7	15.0	19.4
13	254	98.0	97.8	26.8	94.0	91.5	90.5	13.2	5.8	6.3	15.0	17.8	13.5
14	255	104.0	104.0	29.0	112.5	108.0	111.0	13.0	10.6	17.6	24.0	13.8	21.2
15	256	94.5	90.5	30.0	100.5	97.0	100.0	10.0	6.8	7.8	17.8	15.4	13.6
16	257	95.0	95.5		104.5	102.5		25.0	22.1		18.5	21.6	
17	258	94.0	95.0	31.0	103.5	103.0	99.0	13.2	10.6	8.1	14.6	12.9	17.6
18	260	116.5	111.5	33.0	114.0	112.0	110.0	15.6	7.9	10.7	21.0	11.7	17.1
19	261	92.5	92.0	27.5	96.0	94.8	95.0	22.0	10.9	13.7	19.5	11.4	16.2
20	262	118.0	119.0	28.0	114.5	110.0	95.0	17.4	15.2	10.4	29.4	21.8	12.1
21	263	96.0	90.0	27.0	102.5	101.0	100.0	7.9	12.5	6.6	16.0	13.0	13.0
22	264	94.5	98.0	26.0	99.0	101.0	97.0	9.8	5.5	12.8	32.0	21.5	18.7
23	265	88.0	89.5	28.0	97.0	96.2	96.0	14.2	24.3	9.9	19.0	26.6	15.4
24	266	96.0	97.0	29.0	107.5	104.8	105.0	20.2	12.4	13.1	20.6	17.8	15.9
25	267	108.4	102.0	26.5	113.5	103.8	102.0	6.5	2.5	11.2	6.6	13.3	11.1
26	268	89.5	89.0	28.0	93.0	92.0	94.0	13.6	8.9	9.2	17.3	21.0	15.6
27	269	100.0	89.5	29.5	102.5	97.0	92.5	11.2	20.8	11.7	12.5	20.8	13.7
28	270	99.0	94.0	30.0	106.5	102.0	100.5	11.0	9.3	11.8	12.0	20.5	12.7
29	271	105.0	103.5	30.0	104.0	103.0	104.0	8.0	6.8	7.6	10.5	9.5	15.1
30	272	118.0	113.0	30.0	111.5	107.0	104.0	20.7	12.9	18.0	23.3	15.3	19.5
31	273	96.0	96.0	27.0	101.0	98.0	97.0	20.3	15.5	10.8	20.7	17.5	13.0
32	274	95.0	95.7	27.5	104.5	103.5	100.0	8.4	14.5	12.1	21.4	25.3	15.4
33	275	93.5	93.2	28.0	98.0	94.8	96.0	10.2	24.2	14.3	13.5	27.2	13.2
34	276	97.5	98.8	26.5	100.0	99.5	96.0	8.7	6.7	13.7	20.4	14.5	15.1
35	278	105.5	100.0	29.0	110.0	105.8	102.0	18.8	10.6	7.5	20.4	24.0	20.4
36	205	109.0	106.5	28.5	107.0	102.0	99.5	42.3	13.6	14.1	43.8	16.6	14.6
37	279	104.0	104.0	29.0	110.5	109.5	111.5	9.8	14.8	14.5	17.0	21.8	12.5
38	280	97.0	94.5	26.0	101.0	98.8	98.0	5.8	19.6	5.5	8.8	21.4	9.3
39	281	99.0	99.0	30.0	105.0	106.0	101.0	9.9	11.2	11.3	10.8	12.9	14.4
40	207	95.5	96.0	27.0	101.0	97.5	99.0	8.8	10.5	12.9	12.9	14.7	14.8

Sl. No.	Ref .No	Stofr1	Stofr2	Stofr3	Shobr 1	Shobr 2	Shobr 3	Bmir 1	Bmir 2	Bmir 3	Whrr1	Whrr2	Whrr3
1	240	21.0	46.1		24.0	26.2		31.7	31.1	0.0	1.0	1.0	
2	241	28.0	34.2	31.3	30.0	26.4	32.8	28.1	28.3	28.5	1.0	1.0	1.0
3	242	23.4	32.1	24.8	18.3	32.8	23.4	31.1	30.6	29.4	0.9	0.9	0.9
4	244	35.0	32.8	36.3	33.0	29.0	10.5	30.0	30.0	29.6	1.0	1.0	1.0
5	245	32.0	25.6	24.7	34.5	29.3	12.6	26.3	25.7	25.2	1.0	0.9	0.9
6	246	32.0	36.9		25.4	24.3		27.1	26.9	0.0	1.0	1.0	
7	248	40.0	28.3	28.3	35.0	32.5	13.3	29.6	28.4	28.9	1.0	1.0	1.0
8	249	32.0	22.4	29.9	29.0	24.2	21.6	29.8	29.4	29.4	1.0	1.1	1.0
9	250	33.0	28.1	31.9	17.5	23.6	24.5	26.1	26.1	26.6	1.0	1.0	1.0
10	251	24.0	30.9	37.2	26.0	13.0	20.2	28.7	29.4	29.2	1.0	0.9	1.0
11	252	43.0	35.3	28.5	41.2	34.7	20.8	30.4	30.6	30.6	1.0	1.0	0.9
12	253	25.0	32.5	32.1	30.0	34.8	26.4	28.8	28.6	28.5	0.9	0.9	0.9
13	254	28.0	29.7	14.4	21.0	25.0	26.1	26.3	26.3	25.9	1.0	1.1	1.0
14	255	40.0	29.1	32.6	22.0	26.0	29.0	31.4	31.0	31.3	0.9	1.0	0.9
15	256	29.0	35.5	30.5	29.0	20.1	27.7	26.4	25.5	26.1	0.9	0.9	0.9
16	257	32.6	31.5		25.0	32.1		25.7	25.6	0.0	0.9	0.9	
17	258	26.0	27.6	19.3	20.0	20.8	18.5	28.4	28.9	28.2	0.9	0.9	0.9
18	260	36.0	26.3	37.2	23.0	22.4	33.0	33.2	32.8	33.1	1.0	1.0	1.0
19	261	38.0	23.9	18.1	34.0	24.6	24.9	26.0	25.8	25.6	1.0	1.0	0.9
20	262	52.7	33.4	16.8	43.0	28.1	19.5	34.8	34.9	26.3	1.0	1.1	0.9
21	263	28.0	23.1	26.4	19.5	21.9	17.2	25.3	24.8	25.1	0.9	0.9	0.9
22	264	38.0	25.6	16.6	23.0	21.6	17.0	28.3	28.8	27.5	1.0	1.0	0.9
23	265	20.0	26.5	27.5	31.0	33.6	26.3	27.3	27.4	27.7	0.9	0.9	0.9
24	266	39.0	22.5	20.6	30.0	20.8	17.9	27.8	27.8	27.8	0.9	0.9	0.9
25	267	34.2	28.6	27.0	18.5	22.2	18.1	28.6	27.7	26.8	1.0	1.0	1.0
26	268	32.0	25.3	17.5	34.0	29.2	27.5	27.1	27.7	27.7	1.0	1.0	0.9
27	269	22.3	26.0	14.1	19.3	24.7	17.8	29.8	26.5	26.7	1.0	0.9	1.0
28	270	31.2	20.0	22.9	29.1	27.4	24.6	26.8	27.2	27.4	0.9	0.9	0.9
29	271	41.0	30.9	36.0	30.6	26.7	24.5	28.0	27.8	28.1	1.0	1.0	1.0
30	272	46.3	38.0	32.6	27.9	26.4	21.8	32.8	32.1	30.8	1.1	1.1	1.0
31	273	25.3	16.1	26.2	26.0	20.0	24.5	28.3	26.9	27.2	1.0	1.0	0.9
32	274	41.6	32.7	28.4	33.0	37.0	33.8	27.1	26.6	26.1	0.9	0.9	0.9
33	275	25.7	28.9	24.0	26.0	31.6	24.9	28.3	25.9	26.2	1.0	1.0	0.9
34	276	29.0	35.5	24.9	20.0	26.1	17.7	25.8	26.1	24.6	1.0	1.0	0.9
35	278	35.8	20.2	18.2	35.9	28.1	24.5	27.5	26.4	25.8	1.0	0.9	0.9
36	205	33.4	23.5	20.0	35.5	36.6	31.6	31.0	30.4	30.0	1.0	1.0	1.0
37	279	43.0	33.4	30.8	38.0	26.5	22.5	33.3	33.3	34.2	0.9	0.9	1.0
38	280	20.9	17.3	26.5	17.1	29.1	23.8	25.7	25.5	25.5	1.0	1.0	1.0
39	281	26.8	21.8	28.6	29.2	30.6	28.0	29.4	29.8	29.6	0.9	0.9	1.0
40	207	22.0	33.8	36.7	21.1	28.4	25.9	27.9	27.2	28.1	0.9	1.0	1.0

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Original Article

Complementary/alternative Medicine Section

Effect of Integrated Approach of Yoga Therapy on Male Obesity and Psychological Parameters-A Randomised Controlled Trial

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ABSTRACT

Introduction: Obesity is a growing global epidemic and cause of non-communicable diseases. Yoga is one of the effective ways to reduce stress which is one of the causes of obesity.

Aim: To assess the effect of Integrated Approach of Yoga Therapy (IAYT) yoga module on adult male obesity in an urban setting.

Materials and Methods: RCT (Randomized Controlled Trial) was conducted for 14 weeks on obese male subjects with yoga and control groups. Total number of subjects were 72 and they were randomized into two groups (Yoga n=37, Control n=35).The subjects were from an urban setting of Mumbai and were doing yoga for the first time. Special yoga training of IAYT was given to yoga group for one and half hour for 5 days in a week for 14 weeks. The control group continued regular physical activities and no specific physical activity was given. The assessments were anthropometric parameters of weight, Body Mass Index (BMI), MAC (Mid Upper Arm Circumferences) of Left and Right Arm, Waist Circumference (WC), HC (Hip Circumference), WHR (Waist Hip Ratio), SKF(Skin Fold Thickness of Biceps, Triceps, Sub scapular, suprailiac and cumulative), Percentage body fat based on SKF and Psychological Questionnaires of Perceived Stress Scale (PSS) and AAQW (Acceptance and Action Questionnaire for Weight Related Difficulty). These were taken before and after intervention for both yoga and control groups. Within and between group analysis & correlation of differences from post to pre readings among the variables, were carried out using SPSS 21.

Results: The anthropometric and psychological parameters were improved in both the groups but changes were significant in yoga group.

Conclusion: Incorporating the IAYT for obese male in urban setting will be effective for obesity treatment and for reducing the obesity related problems.

Keywords: Body mass index, Obesity, Perceived stress scale, Waist circumference

INTRODUCTION

Obesity/overweight is a serious disorder and this is becoming severe worldwide [1-3]. It is increasing in urban population in India and other south Asian countries [4]. The new solutions for prevention and control of obesity is to be evolved. Effective methods are needed for controlling obesity in India [5,6]. Also, studies showed that non-communicable diseases like obesity are originating from factors of lifestyle and urbanization [7]. Study showed that obesity is a public health problem in some cities of India including Mumbai [8]. Sedentary behaviour due to greater economic development in metro cities also have link to obesity. Obesity is a root cause for many diseases including metabolic syndrome and type-2 diabetes mellitus in India [9].

Study showed that among Indians, both abdominal and central obesity are present in male and female [10]. Generalized obesity is more in male and abdominal obesity in female. Also, studies showed that Asian Indians have some special features of obesity regarding effect of excess body fat [11]. The limits of normal Body Mass Index (BMI) are reduced in Asian Indians than in white Caucasians considering percentage body fat. The obesity is generally measured by BMI. BMI greater than or equal to 25 kg/m^2 is considered as overweight and greater than or equal to 30 kg/m^2 is obesity by WHO. However, for Asian population the BMI cut-off points are much lesser and BMI between 23 to 25 kg/m^2 is considered as overweight and above 25 kg/m^2 is considered as obese [12,13].

Generally obesity is considered as unbalance of energy intake and energy expenditure. The excessive intake of sugar and junk food causes deposition of fat [14]. Obesity is also linked to behavioural changes and social networks [15]. The mechanism of development of obesity is not completely understood but causes are many like stress, environmental, behavioural, lifestyle, genetic factors etc., [16,17].

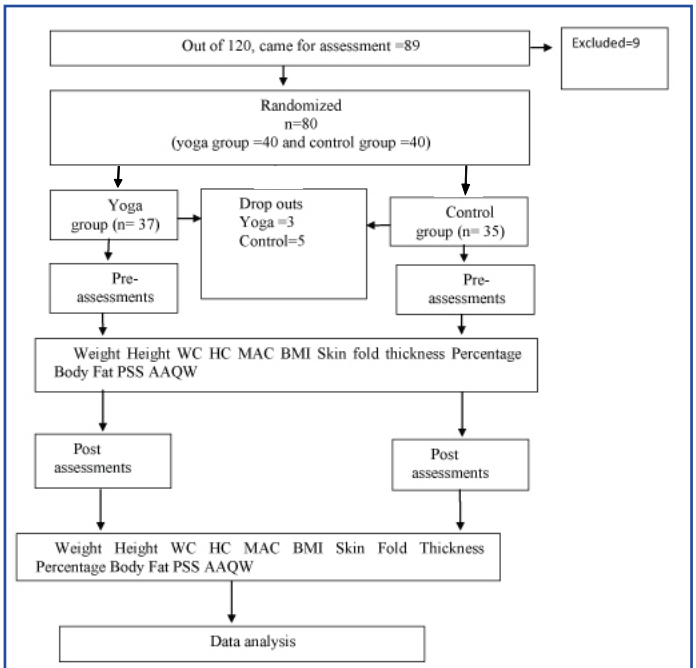
The present solutions for reduction and prevention of obesity are limited and have adverse effects [6]. Hence, it is prudent to explore the treatments from alternative therapies like yoga, pilate, tai-chi, etc. The psychological stress will be reduced by yoga as per its definition in the Patanjali yoga sutras [18]. Yoga is defined as inhibition of modification of thoughts [19]. The mental stress is closely related to psychosomatic diseases and yoga practice is useful for reduction of stress [20]. Also earlier studies showed that Yoga will help to increase awareness on satiety and sense of overeating [21]. There are short term studies showing the usefulness of Yoga practices for weight reduction [22]. However studies of the long term yoga training for weight reduction along with weight related psychological parameters were not found. The aim of the present study was to find out the effect of 14 weeks Integrated Approach of Yoga Therapy (IAYT) practice on male obesity parameters in urban setting.

MATERIALS AND METHODS

Participants

The study was a parallel group study with yoga and control groups. The yoga group was given the intervention of yoga training.

There were total 120 subject who showed desire for joining the research when contacted through advertisement. The subjects were living in Mumbai. They were mostly employees or family members of employees near Anushaktinagar of Mumbai. Total 80 enrolled based on selection criteria. Randomization with minimization of co-factors was done. Total 40 subjects were assigned in yoga group and 40 in control group. The minimization was done using open source software of Minim Py to have balance between groups [23,24]. It is reported that minimization is effective and is desirable in RCTs [25]. These were groups of age (18 to 40 and 41 to 60) and groups of education (up to graduates and post-graduates/ above). The trial profile is given in [Table/Fig-1].



[Table/Fig-1]: Trial profile of RCT.

Sample Size

The sample size was calculated based on previous study using G*Power software [26,27]. Out of four primary outcomes variable HC (hip circumference) had lowest effect size and this was considered to calculate sample size in the current study and got minimum sample size as 29.

Ethical Clearance

Approval of institutional ethical committee was obtained.

Informed Consent

Informed consent was taken from participants prior to recruitment.

Screening

Screening for obesity was done based on BMI as per selection criteria. Selection criteria was BMI from 23 Kg/m^2 to 35 Kg/m^2, Gender male, age 18 to 60years and having normal health conditions except obesity. Each individual was given an alphanumeric code and removing personal identifiers.

Part No	Yoga Practice	Duration (minutes)
1	Lecture & Counselling	10
2a	Warm Up	10
2b	Suryanamaskara	10
3	Asana	30
4	Pranayama	15
5	Meditation	15
	Total duration	90

[Table/Fig-2]: The five part IAYT intervention.

Intervention

The IAYT consisting of Asanas, Pranayama, Relaxation and Meditation techniques were introduced in a slow step by step manner. Each session of the intervention was for 90 minutes for five days in a week for 14 weeks. Details of the yoga intervention are provided in [Table/Fig-2].

No specific physical activity was given to control group but asked to continue their regular physical activities which they have been practicing. The intervention was done during March to June in 2015.

Components across both the groups:- Participants received their respective measurement values and a food log format and basic sample meal plan for sedentary male adults based on guidelines of NIN (National Institute of Nutrition Hyderabad) [28].

Assessments

The assessments were wt.(Body Weight), BMI (Body Mass Index), MAC (Mid Upper Arm Circumference) for both right and left upper arms, WC (Waist Circumference), HC (Hip Circumference), WHR (Waist Hip Ratio), ABSI (A Body Shape Index), SKF (Skin Fold Thickness) at 4 body points applicable for male [29]. These were at right upper arm biceps (SKFraf) right upper arm triceps (SKFrab), sub scapular (SKFshob), suprailiac (SKFstof). Percentage body fat was based on cumulative skin fold thickness SKF from table applicable for male [30].

The PSS (Perceived Stress Scale) and AAQW (Acceptance and Action Questionnaire in Weight related difficulties) were assessed [31-33]. The same scales were used for pre and post assessments. The weight was measured using electronic weighing scale. For height inelastic measuring tape and ruler were used and subjects stood against the wall. Waist circumference was measured at the midway between the lowest rib margin and iliac crest and hip circumference at the widest trochanters, with inelastic tape. The standard skin fold caliper was used to measure skin fold thickness [29,34].

STATISTICAL ANALYSIS

The data was analysed using SPSS software 21 version. Normality test was done using Shapiro wilk test. The paired sample t-test was done for pre-post for both groups on all the variables which were found normally distributed. For not normally distributed parameters, Wilcoxon signed ranks test was done. Between groups analysis was done using independent sample t-test for the post values of the groups. Correlation of differences from post to pre readings, among the variables was carried out. A value of $p<0.05$ was considered statistically significant.

RESULTS

The baseline demographic data of age and height of the yoga and control group are given in [Table/Fig-3]. Results of within group analysis of the anthropometric and psychological parameters are given in [Table/Fig-4a,b]. Between group analysis results are given in [Table/Fig-5]. The pre-post change in each variable was co related with each other and given in [Table/Fig-6].

The minimum age in yoga group was 26 and maximum 60 whereas in control group minimum was 21 and maximum was 58 years. The BMI of yoga group ranged from 25.33 to 34.84 with the mean ±SD 28.7±2.35. BMI of control group ranged from 25.01 to 33.64 with the mean ±SD 27.70±2.05. The demographic, educational and

Variable	Yoga group n=37		Control Group n=35	
	Pre	95% CI	Pre	95% CI
Age	40.03±8.74	(37.12-42.94)	42.20±12.06	(38.76-46.89)
Height	169.45±7.35	(167.00-171.90)	169.29±6.37	(167.17-171.65)

[Table/Fig-3]: Baseline data of age and height.

Variables	Yoga group n=37				Control group n=35			
	Pre	Post	t	Sig	Pre	Post	t	Sig
Weight- wt	82.63±10.05	81.51±10.00	3.1	0.004	79.45±8.85	79.22±8.93	0.94	0.353
MAC left arm -macl	29.98±2.02	29.42±1.92	2.53	0.016	32.53±16.53	28.10±1.70	1.61	0.118
MAC right arm - macr	30.18±2.04	29.64±2.04	2.48	0.018	32.47±16.73	28.10±1.85	1.57	0.125
Hip circumference-HC	103.50±5.71	101.29±4.95	5.39	<0.001	104.28±6.60	101.38±6.13	4.54	<0.001
Triceps-SKF right arm back side- Rab	19.05±7.01	17.87±5.05	0.89	0.379	13.70±6.57	13.22±4.24	0.45	0.652
Suprailiac-SKF at stomach front side- Stof	32.45±7.82	28.04±5.45	3.29	0.002	27.46±9.37	25.57±7.06	1.15	0.259
Sub scapular-SKF shoulder back side-Shob	27.87±6.97	26.91±5.23	0.86	0.396	21.76±7.11	22.28±4.98	-0.38	0.707
BMI	28.7±2.35	28.33±2.42	2.82	0.008	27.70±2.05	27.61±2.01	1.04	0.306
ABSI	0.08±0.00	0.08±0.00	0.97	0.337	0.08±0.00	0.08±0.00	4.02	<0.001
SKF cumulative	93.93±22.56	85.52±13.38	2.23	0.032	73.65±20.61	72.17±14.55	0.4	0.693
PSS	16.51±6.12	12.59±6.65	3.83	<0.001	14.29±6.51	13.51±5.95	0.69	0.493
AAQW-aaqw	81.24±17.35	71.54±14.62	3.9	<0.001	73.11±14.80	69.71±16.28	1.24	0.224

[Table/Fig-4a]: Within group analysis results.

Variables	Yoga group n=37				Control group n=35			
	Pre	Post	Z score	Sig asymp. sig (2-tailed)	Pre	Post	Z score	Sig asymp. sig (2-tailed)
WC	99.58±7.37	98.25±7.12	-2.06[b]	0.039	99.28±6.82	95.79±8.33	-3.71b	<0.001
Biceps-Raf	14.55±7.19	12.70±5.02	-1.42[b]	0.156	10.72±5.00	11.10±3.69	-0.672[c]	0.502
WHR	0.96±0.04	0.97±0.05	-1.82[c]	0.069	0.95±0.06	0.94±0.06	-0.82[b]	0.413
Percentage Body Fat (PFC)	30.78±4.37	29.66±3.30	-1.96[b]	0.051	27.55±5.17	27.58±5.29	-0.03[c]	0.98

[Table/Fig-4b]: Within group analysis results-Non parametric.
a-Wilcoxon signed ranks test b-based on positive ranks c- based on negative ranks

Variable	Yoga - Post-Mean Std dev n=37	Control Post- Mean Std dev n=35	t	Sig (t tailed)	Diff. in Mean 95% CI lower/Upper
Wt	81.51±10.00	79.22±8.93	1.02	0.31	2.29 (-2.17- 6.76)
MACL	29.42±1.92	28.10±1.70	3.07	0.003	1.32 (0.46-2.17)
MACR	29.64±2.04	28.10±1.85	3.35	0.001	1.54 (0.62- 2.46)
HC	101.29±4.95	101.38±6.13	-0.07	0.945	-0.09 (-2.70 – 2.52)
Triceps-Rab	17.87±5.05	13.22±4.24	4.22	<0.001	4.65 (2.42- 6.85)
Suprailiac-Stof	28.04±5.45	25.57±7.06	1.66	0.101	2.47 (-0.49 -5.42)
Sub scapular-Shob	26.91±5.23	22.28±4.98	3.85	<0.001	4.63 (2.23 -7.04)
BMI	28.33±2.42	27.61±2.01	1.37	0.175	0.72 (-0.33 -1.77)
Cumulative skin fold-Skft	85.52±13.38	72.17±14.55	4.06	<0.001	13.35 (6.79 – 19.91)
PSS	12.59±6.65	13.51±5.95	-0.62	0.539	-0.92 (-3.89 -2.05)
AAQW	71.54±14.62	69.71±16.28	0.5	0.618	1.83 (-5.44-9.09)

[Table/Fig-5]: Between group analysis.

anthropometric data were similar in both groups. In each group, out of 40 subjects, 20 were between 10th standard to graduates and 20 were post graduates or higher qualified. In each group number of subjects with age between 18 to 40 was 20 and age between 41 to 60 was 20. In each group all the subjects were working and all were having BMI above 25 Kg/m^2.

The yoga group attended yoga training for 14 weeks and average attendance percentage was 66, 61, 53 and 49 at the completed weeks of 6, 8, 12 and 14 respectively. The control group continued their physical activities.

Anthropometric Parameters

The pre and post-data of the anthropometric parameters were compared. It was found that the weight of the yoga and control groups decreased after the intervention. The weight (wt) reduction in yoga group was significant (p<0.004) and reduction in control group was not significant.

The MACs of both left and right arm were reduced in both Yoga and Control groups. In yoga group left MAC change was significant (p<0.02) and in control group it was not significant. Similarly right MAC of yoga group was reduced and change was significant (p<0.02) and change in control group was not significant.

The WC, Right arm front side SKF, WHR and Percentage body fat based on SKF were not normally distributed. The Bicep SKF and the percentage body fat reduced in yoga group and WHR reduced in control group but were not significant.

The WC in both groups were significant (Yoga p<0.04 & Control p<0.001). The reduction HC was significant in both groups (Yoga p<0.001 and Control p<0.001).

The BMI was reduced in both groups but reduction was significant in yoga (p<0.01). The body shape index ABSI was also calculated based on WC height and BMI [35-37].

The change in cumulative skin fold thickness was significant in Yoga group alone (p<0.05). However, among the 4 separate measurements of SKF, in yoga group alone, suprailiac SKF change (reduction) was significant (p<0.002). In both groups all the 4 SKF values were reduced except that in control group the sub scapular skin fold thickness and Biceps Raf increased. Also, percentage body fat reduced only in Yoga group (p=0.051) and in control group it was increased but not significant.

Psychological Parameters

The PSS score improvement was significant (p<0.001) in Yoga group alone and in Control group score was improved but change was not significant.

In Yoga group, AAQW score improvement was significant (p<0.001) and in Control group score was improved but not significant.

	WT	MACL	MACR	WC	HC	RAF	RAB	STOF	SHOB	BMI	WHR	SKFT	PFC	PSS	AAQW
WT	1.00														
MACL	-0.03	1.00													
MACR	-0.02	0.995**	1.00												
WC	0.366**	0.10	0.10	1.00											
HC	0.234*	0.08	0.08	0.396**	1.00										
RAF	0.00	-0.03	-0.04	0.05	-0.02	1.00									
RAB	-0.11	-0.07	-0.07	-0.05	-0.05	0.691**	1.00								
STOF	0.12	-0.01	-0.03	0.08	0.04	0.420**	0.18	1.00							
SHOB	0.07	-0.04	-0.03	0.09	0.02	0.352**	0.277**	0.456**	1.00						
BMI	0.993**	-0.03	-0.02	0.359**	0.231*	-0.01	-0.10	0.11	0.06	1.00					
WHR	0.201*	0.04	0.05	0.770**	-0.275**	0.06	-0.03	0.04	0.07	0.196*	1.00				
SKFT	0.04	-0.05	-0.06	0.06	0.00	0.813**	0.697**	0.735**	0.708**	0.03	0.05	1.00			
PFC	0.12	-0.04	-0.05	0.11	0.02	0.736**	0.630**	0.727**	0.714**	0.11	0.09	0.953**	1.00		
PSS	0.18	-0.279**	-0.281**	0.01	0.09	-0.02	-0.08	-0.01	0.05	0.17	-0.05	-0.02	-0.06	1.00	
AAQW	0.15	-0.01	0.01	0.06	-0.02	0.00	0.03	-0.07	0.09	0.15	0.06	0.01	-0.01	0.215*	1.00

[Table/Fig-6]: Correlations among (n=72) variable.
*. Correlation is significant at the 0.05 level (1-tailed). **. Correlation is significant at the 0.01 level (1-tailed).
WT: weight MACL: Mid arm circumference left MACR: Mid arm circumference right WC: Waist circumference HC: Hip circumference RAF: Biceps skin fold thickness
RAB: Triceps skin fold thickness STOF: Suprailiac skin fold thickness SHOB: Sub scapular skin fold thickness BMI: body mass index WHR: Waist hip ratio
SKFT: Cumulative skin fold thickness PFC: Percentage body fat PSS: Perceived stress scale score AAQW: Action and weight relayed difficulty score

Regarding relative improvements among the variables, weight was positively correlated with HC (r =0.234, p<0.02), WC(r=0.366, p<0.01), SKF suprailiac (r=0.12, p<0.16), PSS score (r= 0.18,p<0.07)and AAQW score (r=0.15, p<0.10). The left MAC was negatively correlated with PSS (r=-0.28, p<0.01) but there was no significant correlation with AAQW.

Also, right MAC was negatively correlated with PSS (r=-0.29, p<0.01) and there was no correlation with AAQW.

SKF suprailiac and SKF sub scapular had positive correlation (r=0.46, p<0.001), triceps and sub scapular skin fold had positive correlation (r=0.28, p<0.01). BMI and HC had positive correlation (r=0.23, p<0.03). PSS was correlated positively with AAQW scores (r=0.22, p<0.04).

In the between group analysis, changes in weight, HC, suprailiac, BMI, PSS and AAQW difference in scores were not significant. The left & right MAC, triceps skin fold thickness, sub scapular skin fold thickness, cumulative skin fold thickness were significant. All values of control group were lesser than yoga group except HC & PSS. None of the subjects reported adverse events during the intervention. This was asked during each session.

DISCUSSION

Most of the anthropometric parameters and all the psychological parameters were improved in Yoga group. Also, in the control group there was improvement. The weight reduction in yoga group was significant (p<0.004) but not in control group. The MACs were reduced in both the groups but reduction was significant in yoga group (p<0.02). The WC (p<0.04) and HC (p<0.001) were reduced in yoga group.

In an earlier study of a two week residential yoga intervention, improvement was noted in the anthropometric parameters on obese male and female participants [38]. The BMI, WC, HC were reduced and reductions were significant. The WHR was not changed in this study and also in another short term yoga and diet change study, on obesity [38,39]. This showed that there was no difference in reduction of fat in the waist and hip. In the current study WHR showed increasing trend, but the change was not significant.

This shows that in the current study, the reduction of fat in Yoga group resulted in more reduction in hip area than in waist area and in Control group more reduction in waist than in Hip. The yoga practices were containing practices for reduction of fat in both waist and hip areas. This included warm up and suryanamaskara as given in the part 2a &2b of the 5 part IAYT yoga module intervention [Table/Fig-2]. The control group also continued to do physical activities which might have resulted in improvement in their anthropometric parameters. They were asked to continue their regular physical activities and also they were given their respective assessment readings and sample food plan details.

The reduction in MAC of both left and right upper arm was significant in Yoga group. The previous studies on obesity and yoga on adults also included the MAC measurement as a part of anthropometric parameters [39]. But in the current study both left as well as right MAC were measured.

In the current study control group MAC was reduced but not significant. In earlier study of short duration, found decrease in MAC and concluded that the reduction may be due to reduction in muscle or skin layer as muscle circumference was not measured separately [39]. In previous study the MAC reduction was significant in control group alone [38]. This could be due to the short duration of 2 weeks intervention among other factors if any. In the current study, in Yoga group for both left and right MACs were improved with significance which shows the effectiveness of the module of Asanas involving arms and shoulder.

In the current study the cumulative skin fold thickness SKF (involving 4 measurements) reduction was significant in yoga group and in Control group there was decrease but not significant. Further the SKF of biceps and triceps were reduced in yoga group but these values were not significant. In both groups all the 4 skin fold thickness values were reduced except in Control group sub scapular and biceps raf were increased. This may be due to lack of physical activities involving hand and shoulder muscles by the Control group. It is also noted that anthropometry and skin fold thickness are best predictors for obesity assessments [40]. SKF reduction was significant in suprailiac [stomach side] of Yoga group alone, out of all 4 SKFs. Also in Yoga group alone the percentage body fat reduced and with significance (p=0.051). This shows that the IAYT yoga intervention is effective in reducing the fat and also reduction at different sites for male.

In psychological instruments PSS and AAQW were used. There was difference in stress levels in PSS and AAQW base values of groups. The PSS is one of the widely used validated scales to assess the psychometric properties evaluated mostly using college students or workers [31]. In the current study all subjects

were working. The PSS is used for measuring perception of stress [41]. In the current study the PSS reduced in both groups but reduction was significant in yoga group alone. The yoga practices were shown to reduce psychological distress in obese in earlier studies [26]. The current study is one of the earliest studies, combining components of anthropometric PSS and AAQW [33]. The AAQW is a 22 item questionnaire for assessing experience based avoidance and psychological inflexibility associated with obesity and obesity factors such as food. The score was reduced in both the groups. Earlier study (both male/female) of 24 weeks showed that greater decrease in weight related experiential avoidance was linked to more weight loss [42]. The current study of only male subjects, also confirms this point. In the current study, the decrease of AAQW score is significant in Yoga group. Hence after the IAYT intervention the experiential avoidance is reduced in Yoga group which also confirms the reduction of stress levels including acceptance of difficult emotions of obese.

Earlier studies showed that 10 days of short term yoga interventions involving Asana, Pranayama, Relaxation techniques give anxiety reduction [43]. Also, previous studies showed that the long term, 2 years yoga practices reduce the mood changes and stress related bio chemical indices [44]. Also, previous residential weight reduction yoga study did not show significance in mood disturbance, when assessed at 3 month follow-up [45]. In current study, improvement in scores in both PSS and AAQW were significant in Yoga group. This may be due to the effect of different relaxation techniques used in intervention namely MSRT (Mind Sound Resonance Technique), OM meditation Cyclic meditation and Savasana.

This is one of the studies exclusively on male population and more than 3 months in an urban setting. The psychological stress is found to increase cortisol secretion and abdominal fat in an exploratory RCT on female [46]. The mindfulness training improves the eating pattern and reduces the fat. The current study also support that the reduction of abdominal fat on male is consistent with reduction in perceived stress. The suprailiac skin fold (stomach front side fat) reduction was significant in yoga group but not in control group.

The between group analysis, (significance on cumulative SKF, triceps, sub scapular, MACs) showed the improvement in the fat reduction in the respective areas in yoga group.

It was found that PSS and weight related psychological inflexibility are positively correlated. In previous study with n=272 & both male and female, weight was positively correlated with HC ($r=0.21$, $p<0.01$) where as in current study ($r=0.234$, $p<0.02$) [26].This supports that weight and HC in male alone also similarly correlated. The weight and WC are positively correlated WC ($r=0.366$, $p<0.01$) in current study whereas in earlier study correlation is ($r=0.22$, $p<0.0001$) [26]. This supports the higher positive correlations of body weight with HC & WC in male obesity similar to previous mixed studies. Also, it is found that there is positive correlation of weight with SKF suprailiac. The SKF suprailiac and sub scapular are positively correlated. This may be due to the similar increase in fat deposition in trunk portion.

STRENGTHS LIMITATIONS AND FUTURE SCOPES

This is an exclusive study on urban male obesity with psychological parameters. This study has compared the variable of anthropometric and scores of PSS and AAQW together. It is found that IAYT is effective for reducing obesity and problems related to avoidance and inflexibility among obese.

Large age variation of subjects was found as a limitation which was considered initially to get more sample size for the longer duration of intervention. However, the urban environment of life style such as easy availability of junk food, occupational stress (all subjects were working) etc., were common for all the subjects. Further both the groups were having similar age variation as minimization of co factors was done. Blinding on the intervention was not possible since the sample were mostly from same locality and once the intervention started the control group were aware of the yoga programme though subtle practical details were not known to them. Also the individual assessment parameters including the food log format and sample food plan were available with control group also. This might have also given them some motivation to do regular physical exercise and walking activities. This might have improved their anthropometric and psychological parameters.

In Yoga group dropouts were minimum due to interactions and lecture sessions as part of the IAYT module. Lecture was on the designated topics of IAYT module with chance for clarifying the doubts to participants.

It was reported that people with interest and some belief in benefit of yoga are more likely to join the yoga studies than who are indifferent to yoga [21]. This may be applicable In the current study also, since subjects were having initial interest and enthusiasm in joining yoga training.

There is scope for future research with different cross-sections of male obesity with adolescence, middle age and beyond, as separate groups. Also overweight and different grades of male obesity in the urban setting can be studied. In the current study on urban setting of Mumbai, the subjects had commonality of food habits, easy availability of junk food, and economic capability since all were working. The social economic and the city environment affects positively to obesity and different grades of obesity can be taken for different studies.

The maintenance of accurate food log plays a vital role in controlling eating. Food monitoring and control affect the obesity and the smart phone or web based such methods will be easier than hand written food log [47,48]. Earlier studies also shows keeping accurate food log is difficult even in web based systems [49]. In the current study we asked participants to write and maintain food log and reminded about that periodically in the class once in a week. More control on food log may give further weight reduction.

Current study confirms that the one and half hour IAYT is an effective alternative measure in this urban setting for different sectors of male obesity. The different sectors can be researched for the relative effectiveness and tailor made usability, in future.

CONCLUSION

The IAYT yoga training is effective in improving the anthropometric parameters of male obesity in urban setting. The weight, BMI, waist circumference and skinfold measurements were decreased. The psychological stress related to body weight difficulties and perceived stress was also reduced by practice of yoga for fourteen weeks. The findings suggest the usefulness of yoga for obesity treatment.

TRIAL REGISTRATION

The trial was registered with the Clinical Trials registry of India CTRI/2015/01/005433

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Internal Medicine Section

Yoga Practice for Reducing the Male Obesity and Weight Related Psychological Difficulties-A Randomized Controlled Trial

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ABSTRACT

Introduction: Obesity is a health disorder and increasing all over the world. It is also a cause for many non-communicable diseases. Yoga practice reduces the stress level which may improve the eating habits and help in weight reduction.

Aim: To assess the final outcome of the effects after 3 months of the 14 weeks yoga training on obesity of adult male in an urban setting.

Materials and Methods: This was a randomized controlled trial with parallel groups (Yoga and Control groups) on male obese. Total 80 subjects with Body Mass Index (BMI) between 25 to 35 kg/cm^2 were enrolled and randomized into two equal groups in which 72 subjects (yoga n = 37 and control n=35) completed the trial. Yoga group mean age ± SD was 40.03±8.74 and Control group mean age±SD was 42.20±12.06. A 14 weeks special IAYT (Integrated Approach of Yoga Therapy) yoga training was given to the Yoga group and no specific activity was given to Control group. The interim results of this study at 14 weeks were covered in another article which is under process. After the 14 weeks of yoga training the Yoga group was asked to continue the yoga practice for the next 3 months and the Control group was not given any physical activity. The final outcome is covered in this paper.

The assessments were anthropometric parameters of body weight(Wt), BMI (Body Mass Index), MAC (Mid-upper Arm Circumferences of left and right arm), WC (Waist Circumference), HC (Hip Circumference), WHR (Waist Hip Ratio), SKF (Skin Fold Thickness) of biceps, triceps, sub scapular, suprailiac and cumulative skin fold thickness value), Percentage body fat based on SKF and Psychological questionnaires of PSS (Perceived Stress Scale) and AAQW (Acceptance and Action Questionnaire for Weight related difficulty). Assessments were taken after 3 months of yoga training, for both Yoga and Control groups. Within group, between group and correlation analyses were carried out using SPSS 21.

Results: Improvement in anthropometric and psychological parameters such as Wt, Percentage body fat, PSS were observed in the final outcome. Also, some of the improvements such as AAQW score were lost in the final outcome, compared to interim results.

Conclusion: The yoga practice is effective for obesity control for adult male in an urban setting.

Keywords: Body mass index, Overweight, Perceived stress scale, Skin fold thickness, Waist circumference

INTRODUCTION

Obesity is a condition of excessive fat accumulation and is a major risk factor for a number of chronic diseases. It is a health disorder and is growing in high income countries, as well as in low and middle income countries [1-3]. This health problem is increasing in cities like Mumbai in India and the causes are urbanization and life style changes, among other factors [4-6]. The previous studies showed that among the Asian Indians, the prevalence of obesity is high in male populations [7,8].

BMI (Body Mass Index) is considered as a measure of obesity. It was observed that for Asian Indians, BMI cut-off points are to be considered much lesser than the WHO standards for categorizing the obesity [9-12]. In our study, subjects with BMI of 25kg/m^2 or above were considered as obese.

In general, obesity is caused by an unbalance in the energy intake and energy expenditure [13]. The causes of obesity are not fully understood but it is a multi factorial disorder. The present options for controlling obesity are inadequate and have adverse effects [14-17]. Yoga is an ancient therapeutic practice based on Patanjali yoga sutras [18-20]. The Integrated Approach of Yoga Therapy (IAYT) consists of yogic practices based on ancient yoga texts and addresses the mind and body in a holistic way. The earlier studies showed that Yoga practice is useful for stress reduction, awareness on satiety, awareness on over eating and weight reduction [21]. The long term effect of yoga after imparting the training is required to be assessed. The aim of this study was to assess the final outcome after 3 months, of obesity parameters, after giving 14 weeks of IAYT training, for adult male, in an urban setting.

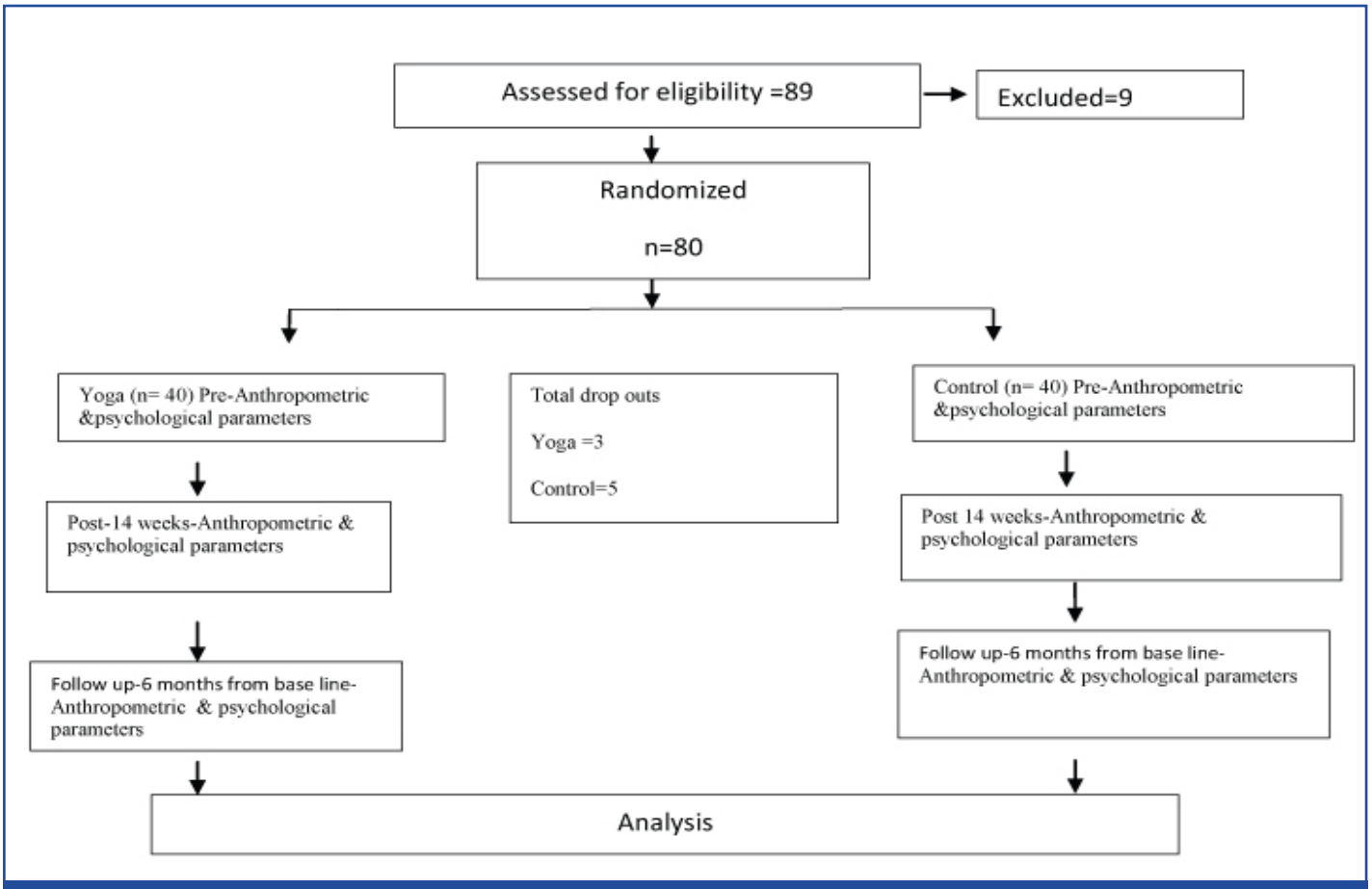
MATERIALS AND METHODS

Participants

The study was a parallel group study with Yoga and Control groups. After training 14 weeks the Yoga group continued practice of yoga, for the next 3 months. The Control group was not given any specific physical activity.

The participants were from north east part of Mumbai. Advertisement was done and total 80 subjects were enrolled based on inclusion criteria. After randomization with minimization of co-factors, 40 subjects were assigned in each group. The IAYT training was given to Yoga group for 14 weeks and assessments outcome were reported in an earlier paper [22]. Further the study was continued and the final results were taken and the outcome is presented in this paper.

The trial profile is shown in [Table/Fig-1]. Open source software, titled MinmPy, was used for randomization with minimization of co



[Table/Fig-1]: Trial profile.

factors [23]. In the inclusion criteria, BMI was from 23 to 35 kg/m^2, and age was from 18 to 60 years. All the participants were male. The subjects who had any surgery during previous six months were excluded. Each participant was given an alpha numeric code to remove all personal identities.

Sample Size

The minimum sample size was determined based on a previous study [24]. In the previous study, out of the 4 primary outcome variables, HC (Hip Circumference) had the lowest effect size and it was considered for calculating the minimum sample size [24]. An open source software, G*Power 3.1 was used and the minimum sample size was determined as 29 [25].

Intervention

The IAYT yoga training consisted of Lecture, Loosening Exercises, Suryanamaskara, Asana, Pranayama and Meditation. All practices were introduced in a slow and progressive manner. Yoga training was for 90 minutes, for five days in a week. After the 14 weeks training Yoga group continued their practice at their home. Regular email, once in a week, was sent to them as a reminder to do yoga practice and requested them to maintain the food log as done during the yoga training. During the final assessment of anthropometric and psychological parameters, after 3 months, all subjects self reported that they were performing yoga practice. The control group was not given any specific physical exercise but they were asked to continue their regular physical activities. The details of the yoga intervention are shown in [Table/Fig-2]. The intervention was during March to September 2015.

Components Across both the Groups

All participants were given their respective measurement records (Pre and Interim at 14 weeks) and the sample meal plan applicable for sedentary male adults, based on guidelines of National Institute of Nutrition Hyderabad [26].

Sr. No.	Yoga practice	Duration in Minutes
1	Lecture & Counselling	10
2a	Loosening Exercises	10
2b	Suryanamaskara	10
3	Asana	30
4	Pranayama	15
5	Meditation	15
	Total duration	90

[Table/Fig-2]: Five part yoga training details.

Assessments

The Wt (Body Weight), BMI, WC (Waist Circumference), HC (Hip Circumference), WHR (Waist hip Ratio), A Body Shape Index (ABSI), Skinfold thickness (SKF) at 4 body points applicable for men and Mid Upper Arm Circumference (MAC) of left and right arms were taken. ABSI was calculated based on WC height and BMI [27-29].

The scores of Perceived Stress Scale (PSS) and Acceptance and Action Questionnaire for Weight Related Difficulty (AAQW) were taken [30-32]. PSS is a validated scale for perceived stress. The AAQW is a validated scale which assesses the experience based avoidance and psychological inflexibility associated with food habits and obesity [32].

For assessing the SKF, skinfold thickness caliper was used [33,34]. The assessments were done at four locations applicable for male [35,36]. The table applicable for men was used for calculating Percentage Body Fat (PFC), based on the cumulative value of skin fold thicknesses [35]. The four measures of SKF were at biceps, triceps, subscapular and suprailiac sites. Each SKF was calculated from the average of three readings. The cumulative SKF was found from sum of the four SKFs. The Wt was measured in electronic weighing scale and circumferences were measured using non elastic tape.

Ethical Clearance

The Institutional Ethical Committee (IEC) clearance was taken.

Informed consent

The informed consent from participants was obtained before recruitment.

Trial Registration

Registered at Clinical Trials registry of India CTRI/2015/01/005433.

STATISTICAL ANALYSIS

Analysis was performed using SPSS software, version 21.0 The normality test was done by Shapiro wilk test. The Paired sample t-test was done for all the parameters, for the first and final values, of both groups, which were found normally distributed. For not normally distributed parameters, the Wilcoxon signed ranks test was done. The Between group analysis was done by independent sample t-test. To find the relative improvement, from Pre to Final values, among the variables, the differences of Pre to Final values were correlated, among each other. A two sided, value of $p<0.05$ was considered statistically significant.

Variable	Yoga group		Control Group	
	Pre	95% C	Pre	95% C
Age	40.03±8.74	(37.12-42.94)	42.20±12.06	(38.76-46.89)
Height	169.45±7.35	(167.00-171.90)	169.29±6.37	(167.17-171.65)
	Min	Max	Min	Max
BMI	25.33	34.84	25.01	33.64

[Table/Fig-3]: Shapiro wilk test was applied for normality.
BMI- Body Mass Index
Pre: Before intervention

Variable	Pre Mean ± Std Dev.	Final Mean ± Std Dev.	t value	Sig	Means 95% C	Lower	Upper
Yoga group							
WT	82.63±10.05	80.47±9.59	2.86	0.007	2.16	0.63	3.68
MACL	29.98±2.02	28.21±1.59	8.34	0.001	1.77	1.34	2.20
MACR	30.18±2.04	28.24±2.07	5.14	0.001	1.94	1.17	2.71
HC	103.50±5.71	99.46±4.76	6.15	0.001	4.04	2.71	5.37
RAB	19.05±7.01	15.26.±2.90	3.54	0.001	3.80	1.62	5.97
STOF	32.45±7.82	26.47±6.69	3.52	0.001	5.98	2.53	9.42
SHOB	27.87±6.97	23.10±5.61	3.27	0.002	4.77	1.81	7.73
BMI	28.7±2.35	27.97±2.21	2.77	0.009	0.73	0.20	1.26
SKFT	93.93±22.56	76.45±11.74	4.37	0.001	17.48	9.36	25.60
PSS	16.51±6.12	12.16±6.90	3.93	0.001	4.35	2.11	6.60
AAQW	81.24±17.35	74.76±16.16	2.46	0.019	6.49	1.15	11.82
Control group							
WT	79.45±8.85	78.82±9.16	1.52	0.139	0.63	-0.22	1.48
MACL	32.53±16.53	28.30±1.86	1.52	0.137	4.23	-1.42	9.89
MACR	32.47±16.73	28.39±2.04	1.46	0.154	4.09	-1.60	9.77
HC	104.28±6.60	100.50±5.79	5.78	0.001	3.78	2.45	5.10
RAB	13.70±6.57	14.77±3.66	-0.94	0.354	-1.07	-3.37	1.24
STOF	27.46±9.37	24.81±6.10	1.80	0.081	2.65	-0.35	5.65
SHOB	21.76±7.11	22.2±6.42	-0.30	0.765	-0.43	-3.36	2.49
BMI	27.70±2.05	27.28±2.55	1.66	0.106	0.42	-0.09	0.93
SKFT	73.65±20.61	72.12±13.88	0.46	0.651	1.53	-5.27	8.33
PSS	14.29±6.51	13.06±6.31	1.42	0.165	1.23	-0.53	2.99
AAQW	73.11±14.80	66.63±14.20	2.83	0.008	5.49	1.55	9.42

[Table/Fig-4]: Within group analysis of normally distributed variables.
Paired sample t test was done for all the above Table/Fig 4
WT: weight
MACL: Mid upper arm circumference of left hand
MACR: Mid arm circumference of right hand
HC: Hip circumference
RAB: Triceps skin fold thickness
STOF: Suprailiac skin fold thickness
SHOB: Sub scapular skin fold thickness
BMI: body mass index
SKFT: Cumulative skin fold thickness
PSS: Perceived stress scale score
AAQW: Action and weight relayed difficulty score

RESULTS

The base line demographic data of age, height and BMI of the groups are given in [Table/Fig-3]. The outcome of within group analysis of anthropometric parameters, for the Yoga and Control groups are given in [Table/Fig-4,5] respectively. The between group analysis at 6 months, is given in [Table/Fig-6]. The relative improvements (from Pre to Final) among the variables are given in [Table/Fig-7]. The comparative data of Pre, Interim and Final are given in [Table/Fig-8].

Variable	Yoga group				Z score	Sig asymp. sig (2-tailed)
	Pre Mean ± Std Dev.	Final Mean ± Std Dev.	t value	Sig		
WC	99.58±7.37	97.12-102.04	95.09±6.76	92.84-97.34	-4.79b	0.001
RAF	14.55±7.19	12.16-16.95	11.62±3.14	10.58-12.67	-2.29b	0.020
WHR	0.96±0.04	0.95-0.98	0.96±0.04	0.94-0.97	-1.41b	0.158
PFC	30.78±4.37	29.32-32.24	28.16±3.45	27.01-29.31	-3.75b	0.001
Variable	**Control group**				**Z score**	**Sig asymp. sig (2-tailed)**
	Pre Mean ± Std Dev.	Final Mean ± Std Dev.	t value	Sig		
WC	99.28±6.82	96.94-101.63	96.29±7.20	93.81-98.76	-3.12b	0.002
RAF	10.72±5.00	9.01-12.43	10.34±3.06	9.29-11.39	-0.57b	0.572
WHR	0.95±0.06	0.93-0.97	0.96±0.05	0.94-0.97	-0.02b	0.987
PFC	27.55±5.17	25.77-29.33	27.64±4.65	26.05-29.24	-0.19c	0.852

[Table/Fig-5]: Within group analysis of not normally distributed variables.
Wilcoxon signed ranks test was done for Not Normally distributed variables
b- based on positive ranks
c- based on negative ranks
WC: Waist circumference
RAF: Biceps skin fold thickness
WHR: Waist hip ratio
PFC Percentage fat(based on skin fold thickness)

Variable	Yoga - Final- Mean Std dev n=37	Control -Final- Mean Std dev n=35	t	Sig (2-tailed)	Diff. in Mean 95% CI lower/Upper
WT	80.47± 9.59	78.82± 9.16	0.75	0.46	1.65 (-2.76 - 6.07)
MACL	28.21±1.59	28.30±1.86	-0.22	0.83	-0.09 (-0.90 – 0.72)
MACR	28.24±2.07	28.39±2.04	-0.31	0.76	-0.15 (-1.11 – 0.82)
HC	99.46±4.76	100.50±5.79	-0.83	0.41	-1.04 (-3.53 – 1.45)
RAB	15.26±2.90	14.77±3.66	--0.63	0.53	0.49 (-1.06 – 2.04)
STOF	26.47±6.69	24.81±6.10	1.10	0.28	1.66 (-1.35 – 4.67)
SHOB	23.10±5.61	22.20±6.42	0.64	0.53	0.90 (-1.93 – 3.73)
BMI	27.97±2.21	27.28±2.55	1.22	0.23	0.68 (-0.43 – 1.80)
SKFT	76.45±11.74	72.12±13.88	1.43	0.16	4.33 (-1.70 – 10.36)
PSS	12.16±6.90	13.06±6.31	-0.57	0.57	-0.89 (-4.01 – 2.22)
AAQW	74.76±16.16	67.63±14.20	1.98	0.06	7.13 (-0.04 – 14.30)

[Table/Fig-6]: Between group analysis.
An independent sample t test was applied between yoga & control groups
WT: weight
MACL: Mid upper arm circumference of left hand
MACR: Mid upper arm circumference of right hand
HC: Hip circumference
RAB: Triceps skin fold thickness
SHOB: Subscapular skin fold thickness
STOF: Suprailiac skin fold thickness
BMI: body mass index
SKFT Cumulative skin fold thickness
PSS: Perceived stress scale score
AAQW: Action and weight relayed difficulty score

In each group, 50% of the total subjects was having educational qualification between 10th standard to graduates and 50% was post graduates or above. Also in each group 50% was in age group of 18 to 40 and 50% was in age group of 41 to 60 years. In each of the groups, all the subjects were working and all were having BMI above 25 Kg/m^2. The minimum age in Yoga group was 26 and maximum was 60 whereas in Control group, minimum was 21 and maximum 58. Thus minimization of co factors was done [23,37,38]. None of the subjects reported any adverse events due to the intervention.

The combined Pre, Interim and Final results given in [Table/Fig-8], shows that some of the gain in the interim values was lost during the final results.

Difference of final –pre values	WT	MACL	MACR	WC	HC	RAF	RAB	STOF	SHOB	BMI	WHR	SKFT	PFC	PSS	AAQW
WT	1.00														
MACL	-0.01	1.00													
MACR	0.01	0.991**	1.00												
WC	0.700**	0.07	0.07	1.00											
HC	0.594**	0.00	0.03	0.656**	1.00										
RAF	0.202*	-0.09	-0.07	0.229*	0.13	1.00									
RAB	0.361**	-0.08	-0.05	0.271*	0.11	0.624**	1.00								
STOF	0.458**	0.01	0.00	0.503**	0.234*	0.350**	0.326**	1.00							
SHOB	0.297**	-0.09	-0.06	0.282**	0.241*	0.328**	0.335**	0.420**	1.00						
BMI	0.854**	-0.02	0.01	0.509**	0.470**	0.205*	0.358**	0.435**	0.272*	1.00					
WHR	0.318**	0.10	0.06	0.670**	-0.12	0.16	0.234*	0.427**	0.14	0.19	1.00				
SKFT	0.462**	-0.08	-0.05	0.455**	0.257*	0.716**	0.723**	0.761**	0.742**	0.443**	0.339**	1.00			
PFC	0.449**	-0.06	-0.04	0.457**	0.249*	0.659**	0.693**	0.728**	0.745**	0.445**	0.354**	0.963**	1.00		
PSS	0.14	-0.291**	-0.300**	0.07	-0.04	-0.02	-0.03	0.07	0.04	0.10	0.14	0.03	0.02	1.00	
AAQW	0.290**	0.01	-0.01	0.295**	0.02	-0.02	0.07	0.19	0.01	0.348**	0.358**	0.10	0.12	0.260*	1.00

[Table/Fig-7]: Correlation analysis on improvement from pre to final readings, among variables.
**. Correlation is significant at the 0.01 level (1-tailed).
*. Correlation is significant at the 0.05 level (1-tailed).
Bivariate -Pearson correlation test applied
WT: weight
WC: Waist circumference
STOF: Suprailiac skin fold thickness
SKFT: Cumulative skin fold thickness
AAQW: Action and weight relayed difficulty score
MACL: Mid arm circumference left
RAF:Biceps skin fold thickness
BMI: body mass index
PSS: Perceived stress scale score
MACR: Mid arm circumference right
RAB: Triceps skin fold thickness
WHR: Waist hip ratio
HC: Hip circumference
SHOB: Sub scapular skin fold thickness
PFC: Percentage fat

Sr. No	Group	Parameter	Pre	Interim	Final	Sig Pre Interim	Sig Pre Final
1	Yoga	WT	82.63±10.05	81.51±10.00	80.47±9.59	0.004	0.007
	Control		79.45±8.85	79.22±8.93	78.82±9.16	0.353	0.139
2	Yoga	MACL	29.98±2.02	29.42±1.92	28.21±1.59	0.016	<0.001
	Control		32.53±16.53	28.10±1.70	28.30±1.86	0.118	0.137
3	Yoga	Macr	30.18±2.04	29.64±2.04	28.24±2.07	0.018	<0.001
	Control		32.47±16.73	28.10±1.85	28.39±2.04	0.125	0.154
4	Yoga	HC	103.50±5.71	101.29±4.95	99.46±4.76	<0.001	<0.001
	Control		104.28±6.60	101.38±6.13	100.50±5.79	<0.001	<0.001
5	Yoga	WC	99.58±7.37	98.25±7.12	95.09±6.76	0.039 (z score -2.06b)	<0.001 (z score -4.79b)
	Control		99.28±6.82	95.79±8.33	96.29±7.20	<0.001 (z score -3.71b)	0.002 (z score -3.12b)
6	Yoga	WHR	0.96±0.04	0.97±0.05	0.96±0.04	0.069 (z score -1.82c)	0.158 (z score -1.41b)
	Control		0.95±0.06	0.94±0.06	0.96±0.05	0.413 (z score -0.82b)	0.987 (z score -0.02b)
7	Yoga	PFC	30.78±4.37	29.66±3.30	28.16±3.45	0.051 (z score -1.96b)	<0.001 (z score -3.75b)
	Control		27.55±5.17	27.58±5.29	27.64±4.65	0.98 (z score -0.03c)	0.852 (z score -0.19c)
8	Yoga	BMI	28.7±2.35	28.33±2.42	27.97±2.21	0.008	0.009
	Control		27.70±2.05	27.61±2.01	27.28±2.55	0.306	0.106
9	Yoga	SKFT	93.93±22.56	85.52±13.38	76.45±11.74	0.032	<0.001
	Control		73.65±20.61	72.17±14.55	72.12±13.88	0.693	0.651
10	Yoga	Biceps-skfraf	14.55±7.19	12.70±5.02	11.62±3.14	0.156 (z score -1.42b)	0.02 (z score -2.29b)
	Control		10.72±5.00	11.10±3.69	10.34±3.06	0.502 (z score -0.672c)	0.572 (z score -0.57b)
11	Yoga	Triceps-skfrab	19.05±7.01	17.87±5.05	15.26.±2.90	0.379	0.001
	Control		13.70±6.57	13.22±4.24	14.77±3.66	0.652	0.354
12	Yoga	suprailiac-skfstof	32.45±7.82	28.04±5.45	26.47±6.69	0.002	0.001
	Control		27.46±9.37	25.57±7.06	24.81±6.10	0.259	0.081
13	Yoga	Subscapular-skfshob	27.87±6.97	26.91±5.23	23.10±5.61	0.396	0.002
	Control		21.76±7.11	22.28±4.98	22.20±6.42	0.707	0.765
14	Yoga	PSS	16.51±6.12	12.59±6.65	12.16±6.90	<0.001	<0.001
	Control		14.29±6.51	13.51±5.95	13.06±6.31	0.493	0.165
15	Yoga	AAQW	81.24±17.35	71.54±14.62	74.76±16.16	<0.001	0.019
	Control		73.11±14.80	69.71±16.28	66.63±14.20	0.224	0.008

[Table/Fig-8]: Pre- Interim- Final Results
Paired sample t test was applied for all Normally distributed variables and Wilcoxon signed ranks test was applied for Not Normally distributed variables
b- based on positive ranks, c- based on negative ranks
WT: weight
MACL: Mid arm circumference left
MACR: Mid arm circumference right
HC: Hip circumference
WC: Waist circumference
WHR: Waist hip ratio
PFC: Percentage body fat
BMI: body mass index
SKFT: Cumulative skin fold thickness
SKFRAF: Biceps skin fold thickness
SKFRAB: Triceps skin fold thickness
SKFSHOB: Sub scapular skin fold thickness
SKFSTOF: Suprailiac skin fold thickness
PSS: Perceived stress scale score
AAQW: Action and weight relayed difficulty score

Anthropometric Parameters

All parameters except WC, WHR, PFC and SKF of biceps were normally distributed.

There was consistent improvement from Pre to Interim to Final result, in the parameters of Wt, HC, BMI, Cumulative skin fold thickness(SKFT), SKF of biceps (SKFraf) and SKF of suprailiac (SKFstof) for both the groups. The Skfstof was improved from Pre to Interim ($p<0.002$) & Interim to Final ($p<0.001$) in the Yoga group. In the Yoga group the improvement in SKFT, in Pre to Final was more significant ($p<0.001$) than in Pre to Interim ($p<0.05$). In Yoga group alone, MACL and MACR were improved consistently from Pre Interim to Final ($p<0.001$ for both MACL and MACR for pre-final). Control group did not improve in these parameters in the final result. The WC ($p<0.001$), WHR, and PFC ($p<0.001$) were improved from Pre to Interim and to Final in Yoga group but in Control group the gain was lost in the final result. The PFC of Control group was increased in the Final (increase was not significant).

The SKF of triceps (SKFrab), in Control group reduced in Interim but increased in Final. In the Control group, the SKF of sub scapular (SKFshob) increased in Interim and remained almost same in the Final.

The Final results, with respect to the Pre values were as below:

The Wt in the Yoga and Control groups were decreased during the 6 months. The Wt reduction in Yoga group alone was significant ($p<0.007$). The upper mid arm circumference of right arm (MACR) and upper mid arm circumference of left arm (MACL) were reduced in both the groups but change in Yoga group alone was significant ($p<0.001$). The WC was reduced in both the groups (yoga $p< 0.001$ and control $p<0.002$).WHR remained same in yoga, increased in control but not significant. In Yoga, the PFC, based on chart, was decreased and was significant ($p<0.001$) [35]. In the Control group it was increased but was not significant. HC was reduced and was significant in both the groups ($p<0.001$). The cumulative skin fold thickness was reduced in both the groups but was significant ($p<0.001$) in Yoga group alone. The SKFrab ($p<0.001$) SKFshob ($p<0.002$) and SKFstof ($p<0.001$) and SKFraf ($p <0.02$) were reduced in Yoga group. In control group SKFstof and SKFraf reduced but were not significant. SKFrab and SKFshob were increased but changes were not significant. The BMI was reduced in both the groups with significance ($p< 0.009$) in Yoga group alone. The cumulative Skin Fold Thickness (SKFT) reduction was significant ($p<0.001$) in the Yoga group alone.

Psychological Parameters

The PSS was improved consistently from Pre Interim to Final in the Yoga group alone ($p< 0.001$). The AAQW was improved in Control group in the Pre-Interim (but not significant) and improved during Pre to Final ($p<0.05$).

In Yoga group, AAQW was improved during the Pre-Interim but was increased (worsened) in Final ($p<0.001$ for Pre-Interim, $p< 0.05$ for Pre-Final).

Compared to Pre values, the improvement in PSS was significant in the Yoga group ($p<0.001$) alone. In both the groups (compared to Pre values) the AAQW improvement was significant (Yoga $p<0.02$ and Control $p<0.01$).

Correlations

The correlations results with respect to, Pre to Final were as below:

BMI was positively correlated to WC ($r=0.509$, $p<0.01$), SKFT ($r=0.443$, $p<0.01$), HC ($r=0.47$, $p<0.01$) and AAQW ($r=0.348$, $p<0.01$). The PSS was not much correlated to BMI. The PSS was negatively correlated to MACL ($r=-0.291$, $p<0.01$) and MACR ($r=-0.300$, $p<0.01$).

DISCUSSION

There was improvement in anthropometric parameters and this was supportive of the earlier studies [39]. In the Yoga group, PFC decrease (improvement) was significant ($p<0.001$) considering the Pre Final values, though decrease of PFC was not significant during Pre to Interim. This shows that the 14 weeks IAYT training had effect in the Final values. The weight reduction was more significant in Pre to Final than in Pre to Interim, and the weight reduction was consistent. This indicates that the reduction of weight was due to fat reduction. The earlier study of 8 week yoga on boys, showed a significant decrease in percentage body fat [39].

Earlier short term study on 2 weeks yoga and walking with diet control (residential study), showed significant improvements in anthropometric parameters, with no change in WHR [40]. Another study showed similar results on WHR [41]. In our non residential study, and without diet control (though sample food plan information were given to both the groups), the WHR was increased in Interim (compared to pre) and decreased in Final (with respect to interim value-but compared to Pre value the Final value remained same) in the Yoga group. The WHR was decreased in Interim and increased in Final, in the Control group. But WC and HC were consistently reduced in Yoga group, in Pre to Interim and Pre to Final. WC was increased from Interim to Final in the Control group. This shows that in the Yoga group, the fat stored centrally and at peripherally was reduced in a similar way. Similar trend was noted in a short duration trial on obese adults [40]. In the Control group the WHR improvement (decrease) may be due to less fat reduction in peripheral area than in abdominal area in the Interim value. The decrease of WHR of Yoga group, in the Final may be due to more decrease of WC than HC. This could be due to yoga practices of the abdomen area.

The MAC was measured as part of anthropometric measurement in the earlier studies also [41]. But we assessed both the right and left MAC. In our study MAC reduction was significant for Yoga group alone ($p<0.001$) both during Pre Interim and Pre Final, which shows some reduction of fat or skin muscle in the upper limb similar to the earlier short duration studies [40].

The SKFT was significant in the Yoga alone ($p<0.05$ in Pre Interim and $p<0.001$ in Pre Final).This supports that there is reduction in MAC skin fold muscle or fat in the upper arms due to yoga practice which included the Suryanamaskara and Asana requiring active movement of upper arms, for one third of the yoga duration. The consistent reduction of fat/muscle in upper arms in Final value also shows the effectiveness of IAYT for obesity control.

This also shows that in long term yoga practice can give more balanced reduction at different parts of the body like upper arm and waist, compared to the Control group. In the Control group, reduction in waist area was lesser and also there was lesser reduction in upper arms. This may be due to their varied regular physical activities. In our study, Yoga group SKFT and PFC reduced consistently from Pre Interim to Final unlike in the Control group and the anthropometry and skin fold thickness give the best predictors for obesity assessment [42].

In Yoga group SKFraf, SKFrab, SKFshob and SKFstof were also consistently reduced from Pre Interim to Final value. In the Control group SKFraf , SKFshob and SKFstof reduced but SKFrab got increased from Interim to the Final. This may be due to lesser physical activities using hand and shoulder. The reduction in weight in the Yoga group was in all parts. The Control group, doing their regular physical activities like walking etc. did not get weight reduction in all parts.

In AAQW and PSS scores, there was difference in Pre values in the groups [30,32]. Earlier studies showed Psycho Immunological effects of yoga and reduction of various stress levels [43-45].

Previous study showed that the decrease in weight related

experiential avoidance is linked to more weight loss in a male female combined batch [46]. But in the Yoga group the AAQW score increased from Interim to final and in the Control group it was decreased in the Final. The significance of reduction in AAWQ was lost in Yoga group. This may be due to lesser yoga practices of meditation such as MSRT (Mind sound resonance technique) which are having a group effect and was part of the yoga training of 14 weeks. During Interim to Final, the subjects were doing yoga alone at their home in unsupervised situations. In control group AAQW score reduction was almost same as Pre to Interim and Interim to Final. There was no group activity for the Control group and each was continuing their own regular physical activities similar to pre interim period.

The PSS was validated using college students or workers [30]. Our all subjects were working. The PSS is used for measuring the perceived stress [47]. In our study PSS reduced with significance ($p<0.001$) consistently in Pre Interim and Pre Final in yoga group alone. The yoga practice reduced anxiety and depression scores in mixed male female obese group of grade 2 obesity, BMI 31.37 ± 6.64 with psychological problems [48]. Improvement in depression and anxiety was mostly correlated with improvements in WC and HC [48]. Our study showed that yoga practice during Interim and Final also reduced the perceived stress in obese male of BMI 28.7±2.3.In IAYT module there are many components such as Suryanamaskara Pranayama Body awareness etc which reduces the stress levels [24]. This shows that in the Final, the stress level was reduced and that also might have improved their food habits and promoted weight reduction.

The Pre Final correlation results show that BMI was positively correlated to WC, SKFT, HC and AAQW. These correlations were supportive to earlier short terms studies [48]. The PSS was negatively correlated to MACL($r=-0.291$, $p<0.01$) and MACR($r=-0.300$, $p<0.01$).Higher MAC indicate chronic energy deficiency [49]. Thus anthropometric and psychological parameters are found to be correlated in obese and the long term yoga practice improves these parameters.

Previous studies showed that short and long term yoga interventions reduce anxiety and mood changes [44,50]. The psychological stress increases cortisol secretion and abdominal fat in an RCT on female [51]. The mindfulness practices modify eating disorders. Our study support that the reduction of abdominal fat in male is consistent with reduction in perceived stress reduction.

Strengths Limitations and Future Scope

Our study is one of the earliest RCTs on male obesity and long term yoga (six months) in urban setting along with assessments of PSS and AAQW. It was reported that people with some belief in yoga join to such programme [21]. Though all our subjects were new to yoga this point is relevant. Future studies can be taken in different cross sections and in different cities where the eating habits and consumption of junk food could be different. The accurate food log plays a vital role in control of the eating and the smart phone or web based methods will be easier than hand written food log [52,53]. The age group in our study was large to get more sample size and for longer period study. However the age distribution was similar in both groups by minimization of co factors. Also the urban human habits of junk food eating, sedentary life etc., are common for all age groups. Further studies can be done with smaller range of age groups and at various cities (probably having varying food habits).

CONCLUSION

The anthropometric parameters and percentage body fat showed improvement in the Final result. Some of the improvements including AAQW score obtained during the 14 weeks training was lost in the Final value. The PSS score was improved consistently. The fat reduction was effective at central and peripheral parts in the Interim to Final result. Reduction of abdominal fat on male is correlated to reduction in perceived stress. The yoga practice is effective for obesity control for adult male in urban setting.

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